

# Faculty of Engineering Savitribai Phule Pune University, Pune



## Syllabus

for

## Third Year of Computer Engineering (Course 2015)

(with effect from **June 2017** )

## Savitribai Phule Pune University, Pune Computer Engineering

### Program Educational Objectives

1. To prepare globally competent graduates having strong fundamentals, domain knowledge, updated with modern technology to provide the effective solutions for engineering problems.
2. To prepare the graduates to work as a committed professional with strong professional ethics and values, sense of responsibilities, understanding of legal, safety, health, societal, cultural and environmental issues.
3. To prepare committed and motivated graduates with research attitude, lifelong learning, investigative approach, and multidisciplinary thinking.
4. To prepare the graduates with strong managerial and communication skills to work effectively as individual as well as in teams.

### Program Outcomes

#### Students are expected to know and be able –

1. To apply knowledge of mathematics, science, engineering fundamentals, problem solving skills, algorithmic analysis and mathematical modeling to the solution of complex engineering problems.
2. To analyze the problem by finding its domain and applying domain specific skills
3. To understand the design issues of the product/software and develop effective solutions with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
4. To find solutions of complex problems by conducting investigations applying suitable techniques.
5. To adapt the usage of modern tools and recent software.
6. To contribute towards the society by understanding the impact of Engineering on global aspect.
7. To understand environment issues and design a sustainable system.
8. To understand and follow professional ethics.
9. To function effectively as an individual and as member or leader in diverse teams and interdisciplinary settings.
10. To demonstrate effective communication at various levels.
11. To apply the knowledge of Computer Engineering for development of projects, and its finance and management.
12. To keep in touch with current technologies and inculcate the practice of lifelong learning.

### Program Specific Outcomes (PSO)

#### A graduate of the Computer Engineering Program will demonstrate-

**PSO1:** Professional Skills-The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying.

**PSO2:** Problem-Solving Skills- The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.

**PSO3:** Successful Career and Entrepreneurship- The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.

**Savitribai Phule University of Pune**  
**Third Year Computer Engineering (2015 Course)**  
**(with effect from 2017-18)**

**Semester I**

Course Code	Course	Teaching Scheme Hours / Week			Examination Scheme and Marks						Credit		
		Theory	Tutorial	Practical	In-Sem	End-Sem	TW	PR	OR	Total	TH/ TUT	PR	
310241	Theory of Computation (TOC)	03	--	--	30	70	--	--	--	100	03	--	
310242	Database Management Systems (DBMS)	03	--	--	30	70	--	--	--	100	03	--	
310243	Software Engineering & Project Management (SE & PM)	03	--	--	30	70	--	--	--	100	03	--	
310244	Information Systems & Engineering Economics (IS & EE)	03	--	--	30	70	--	--	--	100	03	--	
310245	Computer Networks (CN)	04	--	--	30	70	--	--	--	100	04	--	
310246	Skill Development Lab (SDL)	--	02	04	--	--	50	--	50	100	02	02	
310247	DBMS Lab	--	--	04	--	--	25	50	--	75	--	02	
310248	CN Lab	--	--	02	--	--	25	50	--	75	--	01	
<b>Total Credit</b>											18	05	
<b>Total</b>		<b>17</b>	<b>01</b>	<b>10</b>	<b>150</b>	<b>350</b>	<b>100</b>	<b>100</b>	<b>50</b>	<b>750</b>	<b>23</b>		
310249	Audit Course 3											<b>Grade</b>	

**310249-Audit Course 3 (AC3) Options:**

**AC3-I: Cyber Security**

**AC3-II: Professional Ethics and Etiquettes**

**AC3-III: Emotional Intelligence**

**AC3-IV: MOOC- Learn New Skills**

**AC3-V: Foreign Language (Japanese- Module 3)**

**Abbreviations:**

**TW:** Term Work

**TH:** Theory

**OR:** Oral

**TUT:** Tutorial

**PR:** Practical

**Sem:** Semester

Savitribai Phule University of Pune												
Third Year Computer Engineering (2015 Course)												
(with effect from 2017-18)												
Semester II												
Course Code	Course	Teaching Scheme Hours / Week			Examination Scheme and Marks						Credit	
		Theory	Tutorial	Practical	In-Sem	End-Sem	TW	PR	OR	Total	TH/ TUT	PR
310250	Design & Analysis of Algorithms (DAA)	04	--	--	30	70	--	--	--	100	04	
310251	Systems Programming & Operating System (SP & OS)	04	--	--	30	70	--	--	--	100	04	--
310252	Embedded Systems & Internet of Things (ES & IoT)	04	--	--	30	70	--	--	--	100	04	--
310253	Software Modeling and Design (SDM)	03	--	--	30	70	--	--	--	100	03	--
310254	Web Technology (WT)	03	--	--	30	70	--	--	--	100	03	--
310255	Seminar & Technical Communication	--	01	--	--	--	50	--	--	50	01	--
310256	Web Technology Lab	--	--	02	--	--	25	50	--	75	--	01
310257	SP & OS Lab	--	--	04	--	--	25	50	--	75	--	02
310258	ES & IoT Lab	--	--	02	--	--	50	--	--	50	--	01
<b>Total Credit</b>											19	04
<b>Total</b>		<b>18</b>	<b>01</b>	<b>08</b>	<b>150</b>	<b>350</b>	<b>150</b>	<b>100</b>	<b>--</b>	<b>750</b>	<b>23</b>	
310259	Audit Course 4										<b>Grade</b>	

### 310259-Audit Course 4(AC4) Options:

AC4-I: Digital & Social Media Marketing

AC4-II: Green Computing

AC4-III: Sustainable Energy Systems

AC4-IV: Leadership and Personality Development

AC4-V: Foreign Language ( Japanese- Module 4)

### Abbreviations:

TW: Term Work TH: Theory

OR: Oral TUT: Tutorial

PR: Practical Sem: Semester

# SEMESTER I

<b>Savitribai Phule Pune University</b> <b>Third Year of Computer Engineering (2015 Course)</b> <b>310241: Theory of Computation</b>		
<b>Teaching Scheme:</b> TH: 03 Hours/Week	<b>Credit</b> 03	<b>Examination Scheme:</b> <b>In-Sem (Paper): 30 Marks</b> <b>End-Sem (Paper): 70 Marks</b>
<b>Prerequisite:</b> Discrete Mathematics, Fundamentals of Programming Languages		
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• To Study abstract computing models</li> <li>• To learn Grammar and Turing Machine</li> <li>• To learn about the theory of computability and complexity.</li> </ul>		
<b>Course Outcomes:</b> On completion of the course, student will be able to– <ul style="list-style-type: none"> <li>• Able to design deterministic Turing machine for all inputs all outputs</li> <li>• Able to subdivide problem space based on input subdivision using constraints</li> <li>• Able to apply linguistic theory</li> </ul>		
<b>Course Contents</b>		
<b>Unit I</b>	<b>Formal Language Theory and Finite Automata</b>	<b>08 Hours</b>
Introduction to Formal language, introduction to language translation logic, Essentials of translation, Alphabets and languages, Finite representation of language, <b>Finite Automata(FA):</b> An Informal Picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language, Deterministic and Nondeterministic FA(DFA and NFA), epsilon- NFA, FA with output: Moore and Mealy machines -Definition, models, inter-conversion.		
<b>Unit II</b>	<b>Regular Expressions (RE)</b>	<b>07 Hours</b>
Operators of RE, Building RE, Precedence of operators, Algebraic laws for RE, Conversions: NFA to DFA, RE to DFA Conversions: RE to DFA, DFA to RE Conversions: State/loop elimination, Arden's theorem Properties of Regular Languages: Pumping Lemma for Regular languages, Closure and Decision properties.		
<b>Unit III</b>	<b>Context Free Grammars (CFG) and Languages</b>	<b>08 Hours</b>
Introduction, Regular Grammar, <b>Context Free Grammar-</b> Definition, Derivation, Language of grammar, sentential form, parse tree, inference, derivation, parse trees, ambiguity in grammar and language- ambiguous Grammar, <b>Simplification of CFG:</b> Eliminating unit productions, useless production, useless symbols, and $\epsilon$ -productions, <b>Normal Forms-</b> Chomsky normal form, Greibach normal form, Closure properties of CFL, Decision properties of CFL, Chomsky Hierarchy, <b>Application of CFG:</b> Parser, Markup languages, XML and Document Type Definitions.		
<b>Unit IV</b>	<b>Turing Machines (TM)</b>	<b>08 Hours</b>
Turing Machine Model, Representation of Turing Machines, Language Acceptability by Turing Machines, Design of TM, Description of TM, Techniques for TM Construction, Variants of Turing Machines, The Model of Linear Bounded Automata , TM & Type 0 grammars, TM's Halting Problem		

Unit V	Pushdown Automata(PDA)	07 Hours
Basic Definitions, Equivalence of Acceptance by Final State & Empty stack, PDA & Context Free Language, Equivalence of PDA and CFG, Parsing & PDA: Top-Down Parsing, Top-down Parsing Using Deterministic PDA, Bottom-up Parsing, Closure properties and Deterministic PDA.		
Unit VI	Undecidability & Intractable Problems	07 Hours
A Language that is not recursively enumerable, An un-decidable problem that is RE, Post Correspondence Problem, The Classes P and NP : Problems Solvable in Polynomial Time, An Example: Kruskal's Algorithm, Nondeterministic Polynomial Time, An NP Example: The Traveling Salesman Problem, Polynomial-Time Reductions NP Complete Problems, An NP-Complete Problem: The Satisfiability Problem, Tractable and Intractable Representing SAT Instances, NP Completeness of the SAT Problem, A Restricted Satisfiability Problem: Normal Forms for Boolean Expressions, Converting Expressions to CNF, The Problem of Independent Sets, The Node-Cover Problem.		
<b>Books:</b>		
<b>Text:</b>		
<ol style="list-style-type: none"> <li>1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, "Introduction to Automata Theory Languages and Computation", Addison-Wesley 2001. ISBN 0-201-44124-1.</li> <li>2. H.L. Lewis, Christos H. Papadimitriou, "Elements of the Theory of Computation", Prentice Hall, ISBN-10: 0132624788; ISBN-13: 978-0132624787</li> </ol>		
<b>References:</b>		
<ol style="list-style-type: none"> <li>1. John Martin, "Introduction to Languages of The Theory of Computation", 2nd Edition, Mc Graw Hill Education, ISBN-13: 978-1-25-900558-9, ISBN-10: 1-25-900558-5</li> <li>2. Sanjeev Arora and Boaz Barak, "Computational Complexity: A Modern Approach", Cambridge University Press, ISBN:0521424267 9780521424264</li> <li>3. Daniel Cohen, "Introduction to Computer Theory", Wiley &amp; Sons, ISBN 0-471-13772-3</li> <li>4. J. Carroll &amp; D Long, "Theory of Finite Automata", Prentice Hall, ISBN 0-13-913708-4</li> <li>5. Kavi Mahesh, "Theory of Computation : A Problem-Solving Approach", Wiley India, ISBN10 8126533110</li> <li>6. Michael Sipser, "Introduction to the Theory of Computation", Cengage Learning, ISBN-13: 9781133187813</li> <li>7. Vivek Kulkarni "Theory of Computation", Oxford University Press, ISBN 0-19-808458</li> </ol>		

<b>Savitribai Phule Pune University</b> <b>Third Year of Computer Engineering (2015 Course)</b> <b>310242 : Database Management Systems</b>		
<b>Teaching Scheme:</b> <b>TH: 03 Hours/Week</b>	<b>Credit</b> <b>03</b>	<b>Examination Scheme:</b> <b>In-Sem (Paper): 30Marks</b> <b>End-Sem (paper): 70 Marks</b>
<b>Prerequisites :</b> Discrete Mathematics, Data Structures		
<b>Companion Course:</b> 310247 Database Management System Lab		
<b>Course Objectives :</b>		
<ul style="list-style-type: none"> <li>• To understand the fundamental concepts of database management. These concepts include aspects of database design, database languages, and database-system implementation</li> <li>• To provide a strong formal foundation in database concepts, technology and practice</li> <li>• To give systematic database design approaches covering conceptual design, logical design and an overview of physical design</li> <li>• Be familiar with the basic issues of transaction processing and concurrency control</li> <li>• To learn and understand various Database Architectures and Applications</li> <li>• To learn a powerful, flexible and scalable general purpose database to handle big data</li> </ul>		
<b>Course Outcomes :</b>		
On completion of the course, student will be able to–		
<ul style="list-style-type: none"> <li>• Design E-R Model for given requirements and convert the same into database tables.</li> <li>• Use database techniques such as SQL &amp; PL/SQL.</li> <li>• Use modern database techniques such as NOSQL.</li> <li>• Explain transaction Management in relational database System.</li> <li>• Describe different database architecture and analyses the use of appropriate architecture in real time environment.</li> <li>• Students will be able to use advanced database Programming concepts Big Data – HADOOP</li> </ul>		
<b>Course Contents</b>		
<b>Unit I</b>	<b>Introduction</b>	<b>07 Hours</b>
Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications, View of Data, Database Languages, Database System Structure, Data Models, Database Design and ER Model: Entity, Attributes, Relationships, Constraints, Keys, Design Process, Entity Relationship Model, ER Diagram, Design Issues, Extended E-R Features, converting E-R & EER diagram into tables.		
<b>Unit II</b>	<b>Relational Database Design</b>	<b>08 Hours</b>
Relational Model: Basic concepts, Attributes and Domains, Codd's Rules, Relational Integrity: Domain, Referential Integrities, Enterprise Constraints, Database Design: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF, Modeling Temporal Data.		
<b>Unit III</b>	<b>SQL AND PL/SQL</b>	<b>07 Hours</b>
<b>SQL:</b> Characteristics and advantages, SQL Data Types and Literals, DDL, DML, DCL, TCL, SQL Operators, Tables: Creating, Modifying, Deleting, Views: Creating, Dropping, Updating using Views, Indexes, SQL DML Queries: SELECT Query and clauses, Set Operations, Predicates and Joins, Set membership, Tuple Variables, Set comparison, Ordering of Tuples,		



Aggregate Functions, Nested Queries, Database Modification using SQL Insert, Update and Delete Queries. **PL/SQL:** concept of Stored Procedures & Functions, Cursors, Triggers, Assertions, roles and privileges, Embedded SQL, Dynamic SQL.

<b>Unit IV</b>	<b>Database Transactions and Query Processing</b>	<b>08 Hours</b>
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Basic concept of a Transaction, Transaction Management, Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability: Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules, Concurrency Control: Need, Locking Methods, Deadlocks, Time-stamping Methods, Recovery methods : Shadow-Paging and Log-Based Recovery, Checkpoints, Query Processing, Query Optimization, Performance Tuning.

<b>Unit V</b>	<b>Database Architectures</b>	<b>07 Hours</b>
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Client-Server Architecture, 2 Tier and 3 Tier Architecture, Centralized Database Architecture and, **Parallel Databases** : Speedup and Scaleup, Architectures of Parallel Databases.

**Distributed Databases** : Architecture of Distributed Databases, Distributed Database Design, Distributed Data Storage, Distributed Transaction : Basics, Failure modes, Commit Protocols, Concurrency Control in Distributed Database, Introduction to Big Data, Hadoop: HDFS, MapReduce.

<b>Unit VI</b>	<b>NoSQL Database</b>	<b>06 Hours</b>
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Introduction to NoSQL Database, Types and examples of NoSQL Database, Performance, Structured verses unstructured data, Distributed Database Model, CAP theorem and BASE Properties, Comparative study of SQL and NoSQL, NoSQL Data Models, JSON: Overview, Data Types, Objects, Schema, MongoDB- MongoDB shell, data types, CRUD Operations, Querying, Aggregation, Indexing, Replication.

**Books:**

**Text:**

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", 6<sup>th</sup> Edition, McGraw Hill Publishers, ISBN 0-07-120413-X
2. Connally T, Begg C., "Database Systems", Pearson Education, 2002, ISBN 81-7808-861-4
3. Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled", Addison Wesley, ISBN-10: 0321826620, ISBN-13: 978-0321826626

**References:**

1. C J Date, "An Introduction to Database Systems", Addison-Wesley, ISBN: 0201144719
2. S.K.Singh, "Database Systems : Concepts, Design and Application", Pearson, Education, ISBN 978-81-317-6092-5
3. Kristina Chodorow, Michael Dirolf, "MongoDB: The Definitive Guide" ,O'Reilly Publications
4. Adam Fowler, "NoSQL For Dummies", John Wiley & Sons, ISBN-1118905628
5. Kevin Roebuck, "Storing and Managing Big Data - NoSQL, Hadoop and More", ISBN: 1743045743, 9781743045749

<b>Savitribai Phule Pune University</b> <b>Third Year of Computer Engineering (2015 Course)</b> <b>310243: Software Engineering and Project Management</b>		
<b>Teaching Scheme:</b> <b>TH: 03 Hours/Week</b>	<b>Credit</b> <b>03</b>	<b>Examination Scheme:</b> <b>In-Sem (Paper): 30 Marks</b> <b>End-Sem (Paper): 70 Marks</b>
<b>Prerequisite:</b> Fundamentals of Programming Languages		
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• To learn and understand the principles of Software Engineering</li> <li>• To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements.</li> <li>• To apply Design and Testing principles to S/W project development.</li> <li>• To understand project management through life cycle of the project.</li> <li>• To understand software quality attributes.</li> </ul>		
<b>Course Outcomes:</b> On completion of the course, student will be able to– <ul style="list-style-type: none"> <li>• Decide on a process model for a developing a software project</li> <li>• Classify software applications and Identify unique features of various domains</li> <li>• Design test cases of a software system.</li> <li>• Understand basics of IT Project management.</li> <li>• Plan, schedule and execute a project considering the risk management.</li> <li>• Apply quality attributes in software development life cycle.</li> </ul>		
<b>Course Contents</b>		
<b>Unit I</b>	<b>Introduction to Software Engineering, Software Process Models</b>	<b>07 Hours</b>
<b>Software Engineering Fundamentals :</b> Nature of Software , Software Engineering Principles, The Software Process , Software Myths <b>Process Models :</b> A Generic Process Model, Prescriptive Process Models: The Waterfall, Incremental Process(RAD), Evolutionary Process, Unified Process, Concurrent. <b>Advanced Process Models &amp; Tools:</b> Agile software development: Agile methods, Plan-driven and agile development, Extreme programming Practices, Testing in XP, Pair programming. Introduction to agile tools: JIRA, Kanban, <b>Case Studies:</b> An information system (mental health-care system), wilderness weather system		
<b>Unit II</b>	<b>Software Requirements Engineering&amp; Analysis</b>	<b>08 Hours</b>
<b>Requirements Engineering :</b> User and system requirements, Functional and non-functional requirements, Types & Metrics, A spiral view of the requirements engineering process. <b>Software Requirements Specification (SRS):</b> The software requirements Specification document, The structure of SRS, Ways of writing a SRS, structured & tabular SRS for an insulin pump case study, <b>Requirements elicitation &amp; Analysis:</b> Process, Requirements validation, Requirements management. <b>Case Studies:</b> The information system case study - Mental health care patient management system (MHC-PMS)		
<b>Unit III</b>	<b>Design Engineering</b>	<b>08 Hours</b>
Design Process & quality, Design Concepts, The design Model, Pattern-based Software Design. <b>Architectural Design :</b> Design Decisions, Views, Patterns, Application Architectures, <b>Modeling Component level Design:</b> component, Designing class based components, conducting component-level design, <b>User Interface Design :</b> The golden rules, Interface Design steps & Analysis, Design Evaluation, <b>Case Study:</b> WebApp Interface Design		

<b>Unit IV</b>	<b>Project Management: Process, Metrics, Estimations &amp; Risks</b>	<b>08 Hours</b>
<p><b>Project Management Concepts:</b> The Management Spectrum, People, Product, Process, Project, The W5HH Principle, Metrics in the Process and Project Domains, Software Measurement : size &amp; function oriented metrics(FP &amp; LOC), Metrics for Project and Software Quality, <b>Project Estimation</b> :Observations on Estimation, Project Planning Process, Software Scope and feasibility, Resources: Human Resources, Reusable software, Environmental Resources. Software Project Estimation, Decomposition Techniques, Empirical Estimation Models: Structure, COCOMO II, Estimation of Object-oriented Projects, Specialized Estimation <b>Case Study:</b> Software Tools for Estimation, <b>Project Scheduling:</b> Project scheduling: Basic Concepts, Defining a Task Set for the Software Project ,Defining Task Network, Scheduling with time-line charts, Schedule tracking Tools:- Microsoft Project, Daily Activity Reporting &amp; Tracking (DART)</p>		
<b>Unit V</b>	<b>Project Management: Risk Management, Configuration Management, Maintenance &amp; Reengineering</b>	<b>07 Hours</b>
<p><b>Project Risk Management</b> : Risk Analysis &amp; Management: Reactive versus Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Risks Monitoring and Management, The RMMM plan for case study project  <b>Software Configuration Management</b> : The SCM repository, SCM process, Configuration management for WebApps, <b>Case study:</b> CVS and Subversion Tools, Visual Source Safe from Microsoft &amp; Clear Case <b>Maintenance &amp; Reengineering:</b> Software Maintenance, Software Supportability, Reengineering, Business Process Reengineering, Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering</p>		
<b>Unit VI</b>	<b>Software Quality, Maintenance&amp; Improvement</b>	<b>07 Hours</b>
<p>Software Quality, Achieving Software Quality: Software engineering methods, Project Management techniques. Quality control and quality assurance. Software Reliability, SQA Tools, Goals and Metrics, Software Maintenance: Software Maintenance, Supportability, Reengineering, Business Process Reengineering, Software Reengineering, Reverse Engineering, Restructuring: Code, data, the economics of Reengineering Software Process Improvement (SPI) :What is SPI, SPI Process, The CMMI, The People CMM, Case study: SPI frameworks.</p>		
<b>Books:</b>		
<b>Text:</b>		
<ol style="list-style-type: none"> <li>1. Roger Pressman, “Software Engineering: A Practitioner’s Approach”, Mc Graw Hill, ISBN 0-07-337597-7</li> <li>2. Ian Sommerville, “ Software Engineering”, Addison and Wesley, ISBN 0-13-703515-2</li> </ol>		
<b>References:</b>		
<ol style="list-style-type: none"> <li>1. Carlo Ghezzi, "“Fundamentals of Software Engineering", Prentice Hall India, ISBN-10: 0133056996</li> <li>2. Rajib Mall, “Fundamentals of Software Engineering”, Prentice Hall India, ISBN-13: 978-8120348981</li> <li>3. Pankaj Jalote, “An Integrated Approach to Software Engineering”, Springer, ISBN 13: 9788173192715.</li> <li>4. S K Chang, “Handbook of Software Engineering and Knowledge Engineering”, World Scientific, Vol I, II, ISBN: 978-981-02-4973-1</li> <li>5. Tom Halt, “Handbook of Software Engineering”, Clanye International, ISBN-10: 1632402939</li> </ol>		

<b>Savitribai Phule Pune University</b> <b>Third Year of Computer Engineering (2015 Course)</b> <b>310244: Information Systems and Engineering Economics</b>		
<b>Teaching Scheme:</b> TH: 03 Hours/Week	<b>Credit</b>  03	<b>Examination Scheme:</b> <b>In-Sem (Paper): 30 Marks</b> <b>End-Sem (Paper): 70 Marks</b>
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• To prepare the students to various forms of the Information Systems and its application in organizations.</li> <li>• To expose the students to the managerial issues relating to information systems and help them identify and evaluate various options in Information Systems.</li> <li>• To Prepare engineering students to analyze cost / revenue data and should able to do economic analyses in the decision making process to justify or reject alternatives / projects on an economic basis for an organization.</li> </ul>		
<b>Course Outcomes:</b> On completion of the course, student will be able to– <ul style="list-style-type: none"> <li>• Understand the need, usage and importance of an Information System to an organization.</li> <li>• Understand the activities that are undertaken while managing, designing, planning, implementation, and deployment of computerized information system in an organization.</li> <li>• Further the student would be aware of various Information System solutions like ERP, CRM, Data warehouses and the issues in successful implementation of these technology solutions in any organizations</li> <li>• Outline the past history, present position and expected performance of a company engaged in engineering practice or in the computer industry.</li> <li>• Perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives.</li> <li>• Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.</li> </ul>		
<b>Course Contents</b>		
<b>Unit I</b>	<b>Basic of Management Theory &amp; Practices</b>	<b>07 Hours</b>
Role of Information Systems in Organizations, The Information System Manager and his challenges, Concepts of Information Systems, Information Systems and Management Strategy Case Studies - May Include Information Systems in the Indian Railways, Information Systems in an e-Commerce Organization.		
<b>Unit II</b>	<b>Management Information System (MIS)</b>	<b>08 Hours</b>
Managing Information Systems, Ethical and Social Issues, Information Technology Infrastructure and Choices, Information Systems Security and Control, Case Studies - May Include Information Technology Infrastructure in a Bank, Information Technology Infrastructure in a manufacturing / process industry.		

<b>Unit III</b>	<b>Leveraging Information Systems</b>	<b>07 Hours</b>
Information Systems Development and Project Management, Managing Data Resources, Business Process Integration and Enterprise Systems, ICT for Development and E-Governance, Case Studies - May Include in-house or cloud based ERP implementation, UIDAI Unique Identification Authority of India.		
<b>Unit IV</b>	<b>Money and Economic Value</b>	<b>08 Hours</b>
Engineering Economic Decisions, Time Value of Money, Understanding Money Management, Case Studies- Economic decisions done in Multi-national companies.		
<b>Unit V</b>	<b>Economics and Management</b>	<b>07 Hours</b>
Equivalence Calculations under Inflation, Present-Worth Analysis, Annual-Equivalence Analysis. Case Studies -comparative analysis of software enterprises from similar domains.		
<b>Unit VI</b>	<b>Understanding Cash Flow and Taxes</b>	<b>07 Hours</b>
Accounting for Depreciation and Income Taxes, Project Cash-Flow Analysis, Understanding Financial Statements, Case Studies - cash flow analysis done in start-up companies.		
<b>Books:</b>		
<b>Text:</b>		
<ol style="list-style-type: none"> <li>1. Rahul De, "MIS: Management Information Systems in Business, Government and Society", Wiley India, ISBN13: 978-81-265-2019-0.</li> <li>2. Chan S. Park , "Fundamentals of Engineering Economics", 3rd Edition, Pearson Education, ISBN 13: 978-02-737-7291-0</li> </ol>		
<b>References:</b>		
<ol style="list-style-type: none"> <li>1. Efraim Turban, Linda Volonino, Gregory R. Wood "Computer Networking a Top Down Approach Featuring the Internet", 10<sup>th</sup> Edition, Wiley; ISBN13: 978-1-118-96126-1</li> <li>2. William G. Sullivan, Elin M. Wicks, C. Patrick Koelling, Engineering Economy, 16<sup>th</sup> Edition, Pearson Education, ISBN13: 978-01-334-3927-4</li> </ol>		

<b>Savitribai Phule Pune University</b> <b>Third Year of Computer Engineering (2015 Course)</b> <b>310245: Computer Networks</b>		
<b>Teaching Scheme:</b> TH: 04 Hours/Week	<b>Credit</b>  <b>04</b>	<b>Examination Scheme:</b> <b>In-Sem (Paper): 30 Marks</b> <b>End-Sem (Paper): 70 Marks</b>
<b>Prerequisite:</b> Computer Organization and Architecture		
<b>Companion Course:</b> 310248 Computer Network Lab		
<b>Course Objectives:</b>		
<ul style="list-style-type: none"> <li>• To understand the fundamental concepts of networking standards, protocols and technologies.</li> <li>• To learn different techniques for framing, error control, flow control and routing.</li> <li>• To learn role of protocols at various layers in the protocol stacks.</li> <li>• To learn network programming.</li> <li>• To develop an understanding of modern network architectures from a design and performance perspective</li> </ul>		
<b>Course Outcomes:</b>		
On completion of the course, student will be able to–		
<ul style="list-style-type: none"> <li>• Analyze the requirements for a given organizational structure to select the most appropriate networking architecture and technologies</li> <li>• Demonstrate LAN and WAN protocol behavior using Modern Tools.</li> <li>• Analyze data flow between peer to peer in an IP network using Application, Transport and Network Layer Protocols.</li> <li>• Illustrate applications of Computer Network capabilities, selection and usage for various sectors of user community.</li> <li>• Develop Client-Server architectures and prototypes by the means of correct standards and technology.</li> </ul>		
<b>Course Contents</b>		
<b>Unit I</b>	<b>Physical Layer</b>	<b>09 Hours</b>
Introduction of LAN; MAN; WAN; PAN, Ad-hoc Network, Network Architectures: Client-Server; Peer To Peer; Distributed and SDN, OSI Model, TCP/IP Model, Topologies: Star and Hierarchical; Design issues for Layers, Transmission Mediums: CAT5, 5e, 6, OFC and Radio Spectrum, Network Devices: Bridge, Switch, Router, Brouter and Access Point, Manchester and Differential Manchester Encodings; IEEE802.11: Frequency Hopping (FHSS) and Direct Sequence (DSSS)		
<b>Unit II</b>	<b>Logical Link Control</b>	<b>09 Hours</b>
Design Issues: Services to Network Layer, Framing, Error Control and Flow Control. Error Control: Parity Bits, Hamming Codes (11/12-bits) and CRC. Flow Control Protocols: Unrestricted Simplex, Stop and Wait, Sliding Window Protocol, WAN Connectivity : PPP and HDLC		
<b>Unit III</b>	<b>Medium Access Control</b>	<b>09 Hours</b>
Channel allocation: Static and Dynamic, Multiple Access Protocols: Pure and Slotted ALOHA, CSMA, WDMA, IEEE 802.3 Standards and Frame Formats, CSMA/CD, Binary Exponential Back-off algorithm, Fast Ethernet, Gigabit Ethernet, IEEE 802.11a/b/g/n and IEEE 802.15 and IEEE 802.16 Standards, Frame formats, CSMA/CA.		



<b>Unit IV</b>	<b>Network Layer</b>	<b>09 Hours</b>
Switching techniques, IP Protocol, IPv4 and IPv6 addressing schemes, Subnetting, NAT, CIDR, ICMP, Routing Protocols: Distance Vector, Link State, Path Vector, Routing in Internet: RIP, OSPF, BGP, Congestion control and QoS, MPLS, Mobile IP, Routing in MANET : AODV, DSR		
<b>Unit V</b>	<b>Transport Layer</b>	<b>09 Hours</b>
Services, Berkley Sockets, Addressing, Connection establishment, Connection release, Flow control and buffering, Multiplexing, TCP, TCP Timer management, TCP Congestion Control, Real Time Transport protocol(RTP), Stream Control Transmission Protocol (SCTP), Quality of Service (QoS), Differentiated services, TCP and UDP for Wireless.		
<b>Unit VI</b>	<b>Application Layer</b>	<b>09 Hours</b>
Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), Email: SMTP, MIME, POP3, Webmail, FTP, TELNET, Dynamic Host Control Protocol (DHCP), Simple Network Management Protocol (SNMP).		
<b>Books:</b>		
<b>Text:</b>		
<ol style="list-style-type: none"> <li>1. Andrew S. Tenenbaum, "Computer Networks", 5<sup>th</sup> Edition, PHI, ISBN 81-203-2175-8.</li> <li>2. Fourauzan B., "Data Communications and Networking", 5<sup>th</sup> Edition, Tata McGraw- Hill, Publications, 2006</li> </ol>		
<b>References:</b>		
<ol style="list-style-type: none"> <li>1. Kurose, Ross "Computer Networking a Top Down Approach Featuring the Internet", Pearson; 6th edition (March 5, 2012), ISBN-10: 0132856204</li> <li>2. Matthew S. Gast "802.11 Wireless Networks", O'Reilly publications; 2<sup>nd</sup> Edition.</li> <li>3. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols" Prentice Hall, 2004</li> <li>4. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", Wiley, ISBN: 0-470-09510-5</li> </ol>		

**Savitribai Phule Pune University**  
**Third Year of Computer Engineering (2015 Course)**  
**310246: Skill Development Lab**

<b>Teaching Scheme:</b>	<b>Credit (04)</b>		<b>Examination Scheme:</b>
<b>TUT: 02 Hour/Week</b>	<b>Tutorial</b>	<b>PR</b>	<b>TW: 50 Marks</b>
<b>PR: 04 Hours/Week</b>	<b>02</b>	<b>02</b>	<b>OR: 50 Marks</b>

**Prerequisite:-** FPL, C, C++ and Basic JAVA

**Course Objectives:**

- To adapt the usage of modern tools and recent software.
- To evaluate problems and analyze data using current technologies
- To learn the process of creation of data-driven web applications using current technologies
- To understand how to incorporate best practices for building enterprise applications
- To learn how to employ Integrated Development Environment(IDE) for implementing and testing of software solution
- To construct software solutions by evaluating alternate architectural patterns.

**Course Outcomes:**

On completion of the course, student will be able to–

- Evaluate problems and analyze data using current technologies in a wide variety of business and organizational contexts.
- Create data-driven web applications
- Incorporate best practices for building applications
- Employ Integrated Development Environment(IDE) for implementing and testing of software solution
- Construct software solutions by evaluating alternate architectural patterns.

**Guidelines for Instructor's Manual**

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

**Guidelines for Student Journal**

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept in brief, features of tool/framework/language used, Design, test cases, conclusion. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

**Guidelines for Assessment**

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.



### Guidelines for Practical Examination

**It is recommended to conduct examination based on Mini-Project demonstration and related skill learned.** Team of 3 to 4 students may work on mini-project. During the assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation and software engineering approach followed. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding, effective and efficient implementation and demonstration skills. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

### Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

**For this laboratory total five Skill Development Modules plus one Aptitude Development Module are provided as below:**

**SD Module-I: Advanced JAVA and Mobile Application Development**

**SD Module-II: PYTHON and DATA Science with R**

**SD Module-III: Advanced JAVA and GROOVY on GRAILS**

**SD Module-IV: SCHEME and SCALA and GROOVY on GRAILS**

**SD Module-V: Advanced JAVA and Data Science with R**

**SD Module VI: Aptitude Development (To be EXCLUDED for Practical Exam)**

#### **Instructions:**

Each college has to select at least one module out of five modules provided. College can select more than one module too! Set of suggested assignments is provided. Each student must perform 7 to 8 assignments and at least one mini-project provided in each module excluding Module VI. Instructor should frame set of mini projects or guide students to frame the problem statement of mini-project by sticking to technologies in respected module.

Term Work will be based on assignments be carried out by students and **Oral Examination will be based on Mini-Project demonstration and related skill learned ONLY.**

**Operating System recommended :-** 64-bit Open source Linux or its derivative

**Programming tools recommended:** - Open Source C,C++, JAVA, PYTHON, G++/GCC, R, Grails, Groovy, Android Studio for Linux.

### Course Contents

<b>SD Module-I</b>	<b>Advanced JAVA and Mobile Application Development</b>	
	<b>Theory Content for Lab</b>	

## ADVANCED JAVA

**Data Structures in Java:** Enumeration, BitSet, Vector, Stack, Dictionary, Hashtable, Properties.

**Generics and Collection Framework:** Generic Methods and Generic Classes. Interfaces (Set, List, Queue, and Dequeue) and classes (ArrayList, Vector, LinkedList, PriorityQueue, HashSet, LinkedHashSet, and TreeSet). **Serialization and Networking:** Serializing an Object and Deserializing an Object, Socket Programming. **Database Connectivity and Multithreading:** SQL, JDBC, Thread life cycle, Thread methods, Thread Pools, Executor Service. **GUI in JAVA:** AWT, Applet, Swing.

## MOBILE APPLICATION DEVELOPMENT

**Introduction to Android:** Android Platform Architecture, Basic components of android, Features of ART and Dalvik Virtual Machine, Activity Life Cycle, Intents and Intent Filters, Resources, System Permissions, Android Application Structure, Device screen size compatibility, Android Emulator

**User Interface components:** Layouts, RecyclerView, ListView, GridView and WebView, Input Controls: Buttons, Checkboxes, Radio Buttons, Toggle Buttons, Spinners, Input Events, Menus, Toast, Dialogs, Styles and Themes, **Multimedia, Animation and Graphics:** Playing Audio, Playing Video, Rotate Animation, FadeIn/FadeOut Animation, Zoom Animation, Scale Animation, 2D and 3D Graphics. **Data Storage:** Shared Preferences, Internal Storage, External Storage, SQLite Databases, Content provider. and Remote Databases, **Advanced Components of Android:** Web App, JSON Parsing, Google Map, GPS, Sensors, Bluetooth/Wi-Fi Connectivity

### Books:

#### Text:

1. Java: The Complete Reference, Herbert Schildt, TMG Publication, ISBN 9780070636774 , 7th Edition
2. Java generics and collections, Thomas Powell, O'Reilly Media, ISBN: 0596527756, 2006.
3. Android Studio 2 Development Essentials Paperback by Neil Smyth
4. Android Programming for Beginners Paperback by John Horton

#### Reference:

1. Sharanam Shah and Vaishali Shah , “JAVA EE 7 for Beginners”, SPD, ISBN: 13:978-93-5110-349-3
2. Reto Meier, “Professional Android 4 Application Development”, 3rd Edition
3. Android Design Patterns, “Interaction Design Solutions for Developers 1st Edition”, Kindle Edition by Greg Nudelman

## Suggested List of Laboratory Assignments for Advanced JAVA

- |    |   |
|----|---|
| 1. | Design a system with the help of advance data structures in Java and enhance the system using collections and generics.                     |
| 2. | Enhance the above system with the help of socket programming use client server architecture.  |
| 3. | Enhance above system by using JDBC, Multithreading, concurrency, synchronous and asynchronous callbacks, ThreadPools using ExecutorService. |
| 4. | Transform the above system from command line system to GUI based application  |

## Suggested List of Laboratory Assignments for Mobile Application Development

- |    |  |
|----|--|
| 1. | Download Install and Configure Android Studio on Linux/windows platform. |
| 2. | Design a mobile app for media player.                                    |
| 3. | Design a mobile app to store data using internal or external storage.    |
| 4. | Design a mobile app using Google Map and GPS to trace the location.      |

## Suggested Mini Project on Advanced JAVA and Mobile Application Development

Design and develop a mobile app for beginner trekkers by recording the paths from regular trekkers by using, Material Design Pattern for UI, Storage [SQLite database/File/Shared Preference/cloud], 3. Internet connection /Wi-Fi/Bluetooth, GPS and Google Map.

SD Module-II	PYTHON and DATA Science with R	
	Theory Content for Lab	
<b>PYTHON</b>		
<p><b>Python Basics:</b> Data types, Statements and Expressions, Operators and Math's, Conditionals, Loops, Strings, List , Tuples , Set Operation, Dictionary (Dict), Date and Times.</p> <p><b>Functions, Packages and Classes:</b> Lambda function, Regular expression, Packages, Files, Exception Handling, Classes ,Objects, Method ,class and instance variable, constructor, destructor, inheritance.</p> <p><b>Numpy and Matplotlib :</b>Array operations, Numpy Side Effects, 2D Numpy Arrays , Numpy Basic Statistics, Universal Function, Matplotlib: Introduction, Simple plots, Line API, Legend API, Figures, Subplots, Axes and Ticks.</p> <p><b>Pandas:</b> Look Ups, Selections and Indexing, Filling Methods, Series operation, Handling NaN values, Mapping, Data Frames, Reading Files, Plotting, Joins, Correlation, Histograms, Rolling calculation, Date Time indexing, Grouping, Aggregate Functions, pandas.IO. Data, Panel.</p>		
<b>DATA SCIENCE WITH R</b>		
<p><b>Introduction to Data Science-</b> What is Data Science? Current landscape of perspectives, Skill sets needed, The Data Science Process life cycle, Role of Data Scientist. Data pre-processing. ETL – extract, transform, and load.</p> <p><b>Introduction to R-</b>What is R? Installation of R. Basic features of R. R Objects. Creating Vectors and Matrices. Getting Data in and out of R. Using different packages related to data science. Managing Data frames and Functions.</p> <p><b>Descriptive Statistics using R -</b> Discrete and continuous random variables, densities and distributions .Data Summarization: Measures of Central Tendency, Measures of Dispersion (quartiles, five number summary, variance, standard deviation), Measures of shape (skewness, kurtosis), Measures of association (covariance, correlation), Outliers. Using R for descriptive statistics and data visualization using ggplot2 package.</p> <p><b>Predictive Analysis using Machine Learning Techniques using R:</b> Machine learning - what, how, where. Supervised, unsupervised and semi-supervised learning. Training, validation, testing, generalization, over fitting. Building a Regression model using R.Features and feature engineering. Using Decision trees, Linear classifiers, Naïve Bayes, Nearest neighbor methods in R packages.</p>		
<b>Books:</b>		
<b>Text:</b>		
<ol style="list-style-type: none"> <li>1. Zed A. Shaw, “Learn PYTHON The Hard Way”, Pearson, ISBN: 978-93-325-8210-1, Third Edition, 2017</li> <li>2. Kenneth A Lambert and B L Juneja, “Fundamentals of PYTHON”, CENGAGE Learning, ISBN:978-81-315-2903-4</li> <li>3. Peng, Roger D and Elizabeth Matsui, “The Art of Data Science." A Guide for Anyone Who Works with Data. Skybrude Consulting 200 (2015): 162.</li> <li>4. Evans, James R., and Carl H. Lindner, "Business analytics: the next frontier for decision sciences." Decision Line 43.2 (2012): 4-6.</li> </ol>		
<b>Reference:</b>		
<ol style="list-style-type: none"> <li>1. Allen B Downey, “Think PYTHON”, O’Rielly, ISBN: 13:978-93-5023-863-9, 4<sup>th</sup> Indian Reprint 2015</li> <li>2. Jiawei Han and Micheline Kamber, Morgan Kaufman, “Learning R, Richard Cotton”, O’Reilly, ISBN: 13:978-93-5110-286-1, First Edition, Fourth Indian Reprint 2015</li> </ol>		
<b>Suggested List of Laboratory Assignments on PYTHON</b>		
1.	Getting Started with Python (Example Word count exercise)	
2.	Build the Hangman Game using Python.	
3.	Write python code loads the any dataset (example Game_medal.csv), and plot the graph.	
4.	Write python code loads the any dataset (example Game_medal.csv), and does some basic data	

	cleaning. Add component on data set.
<b>Suggested List of Laboratory Assignments on DATA Science with R</b>	
1.	Getting Started with R installation, R objects and basic statistics.
2.	Using R for data preprocessing, exploratory analysis, visualization.
3.	Using R for correlation and regression analysis.
4.	Data analysis case study using R for readily available data set using any one machine learning algorithm
<b>Suggested Mini Project on PYTHON and DATA Science with R</b>	
1.	Implementing a simple Recommender System based on user buying pattern.
2.	Twitter Sentiment Analysis in Python
3.	Applying linear regression model to a real world problem.
<b>SD Module-III Advanced JAVA and GROOVY on GRAILS</b>	
<b>Theory Content for Lab</b>	
<b>ADVANCED JAVA</b>	
<p><b>Data Structures in Java:</b> Enumeration, BitSet, Vector, Stack, Dictionary, Hashtable, Properties.  <b>Generics and Collection Framework:</b> Generic Methods and Generic Classes. Interfaces (Set, List, Queue, and Dequeue) and classes (ArrayList, Vector, LinkedList, PriorityQueue, HashSet, LinkedHashSet, and TreeSet). <b>Serialization and Networking:</b> Serializing an Object and Deserializing an Object, Socket Programming. <b>Database Connectivity and Multithreading:</b> SQL, JDBC, Thread life cycle, Thread methods, Thread Pools, Executor Service. <b>GUI in JAVA:</b> AWT, Applet, Swing.</p>	
<b>GROOVY on GRAIL</b>	
<p><b>Introduction to Grails:</b> Object Relational Mapping (GORM), Basic CRUD, Scaffolding JSON, REST API, DataSources and Environments  <b>Web Layer:</b> Model ,View ,Controllers (MVC), Redirects and Chaining, Data Binding, Groovy Server Pages, URL Mappings, Plugins, Grails and Hibernate</p>	
<b>Books:</b>	
<b>Text:</b>	
1.	Java: The Complete Reference, Herbert Schildt, TMG Publication, ISBN 9780070636774 , 7th Edition
2.	Java Generics and collections, Thomas Powell, O'Reilly Media, ISBN: 0596527756, 2006.
3.	Beginning Groovy and Grails From Novice to Professional, Christopher M. Judd, Joseph Faisal Nusairat, and James Shingler, Apress, ISBN-13 (pbk): 978-1-4302-1045-0
<b>Reference:</b>	
1.	JAVA EE 7 for Beginners, Sharanam Shah and Vaishali Shah, SPD, ISBN: 13:978-93-5110-349-3
2.	Official Website <a href="http://docs.grails.org/latest/">http://docs.grails.org/latest/</a>
<b>Suggested List of Laboratory Assignments for Advanced JAVA</b>	
1.	Design a system with the help of advance data structures in Java and enhance the system using collections and generics.
2.	Enhance the above system with the help of socket programming use client server architecture.
3.	Enhance above system by using JDBC, Multithreading, concurrency, synchronous and asynchronous callbacks, ThreadPools using ExecutorService.
4.	Transform the above system from command line system to GUI based application
<b>Suggested List of Laboratory Assignments on GROOVY on GRAILS</b>	

1.	Download Install and Configure IDE with Grails Plugins on Windows/Linux platform.
2.	Design a simple web application using Scaffolding data source for CRUD operations
3.	Design a simple web application using MySQL for CRUD operations
<b>Suggested Mini Project on Advanced JAVA and GROOVY on GRAILS</b>	
Design a <b>dynamic</b> web application system(Ex, Employee Payroll System, Student Result System)	
<b>SD Module-IV SCHEME and SCALA and GROOVY on GRAILS</b>	
<b>Theory Content for Lab</b>	
<b>SCHEME and SCALA</b>	
<p><b>SCHEME:</b> lambda calculus, Atoms, Lists, lambda expressions. Functions as first class objects. Control structures, Recursion and continuations, operations on objects, basic input output, Exceptions and conditions, lazy evaluation and streams.</p> <p><b>SCALA:</b> Classes and Objects, Data Types, Control structures, composition and inheritance. Packages.Pattern matching.Collections API.Working with XML.Actors and concurrency. GUI programming in SCALA.</p>	
<b>GROOVY on GRAILS</b>	
<p><b>Introduction to Grails:</b> Object Relational Mapping (GORM), Basic CRUD, Scaffolding JSON, REST API, DataSources and Environments</p> <p><b>Web Layer:</b> Model ,View ,Controllers (MVC), Redirects and Chaining, Data Binding, Groovy Server Pages, URL Mappings, Plugins, Grails and Hibernate</p>	
<b>Books:</b>	
<b>Text:</b>	
1.	R Kent Dybvig, the Scheme Programming Language, Fourth Edition, MIT Press, 1990, ISBN 978-0-262-51298-5.
2.	Martin Odersky, Lex Spoon, and Bill Venners, Programming in SCALA, Second Edition, 2010. Artima.
3.	Beginning Groovy and Grails From Novice to Professional, Christopher M. Judd, Joseph Faisal Nusairat,and James Shingler, Apress, ISBN-13 (pbk): 978-1-4302-1045-0
<b>Reference:</b>	
1.	Cay S Horstmann, Scala for the Impatient, ISBN: 978-81-317-9605-4, Pearson, 2013.
2.	Scala Cookbook, Alvin Alexander, O'Reilly, SPD,ISBN: 978-93-5110-263-2, Aug 2015
3.	Official Website <a href="http://docs.grails.org/latest/">http://docs.grails.org/latest/</a>
<b>Suggested List of Laboratory Assignments on SCHEME and SCALA</b>	
1.	Create a recursive function in Scheme that displays the sum of n odd numbers starting from 1.
2.	Write a program to find sum and product of all the elements of a list in scheme without using built in functions.
3.	Write a SCALA Program to perform following operations on Strings: <ol style="list-style-type: none"> <li>1. Create a String Object.</li> <li>2. Check String is palindrome or not.</li> <li>3. Check length of String</li> <li>4. Replace all 'a' in a string with 'A'</li> </ol>
4.	Develop a SCALA pattern matching programming which matches a given Person object and displays whether he is Eligible for Election or not. Use name, age and eligibility as class members.
<b>Suggested List of Laboratory Assignments on GROOVY on GRAILS</b>	
1.	Download Install and Configure IDE with Grails Plugins on Windows/Linux platform.
2.	Design a simple web application using Scaffolding data source for CRUD operations
3.	Design a simple web application using MySQL for CRUD operations



### Suggested Mini Project on SCHEME and SCALA and GROOVY on GRAILS

Design a dynamic web application system Use Front End: Groovy on Grails, Back End: Scheme and Scala (Ex, Employee Payroll System, Student Result System)

#### SD Module-V

#### Advanced JAVA and Data Science with R

#### Theory Content for Lab

#### ADVANCED JAVA

**Data Structures in Java:** Enumeration, BitSet, Vector, Stack, Dictionary, Hashtable, Properties.

**Generics and Collection Framework:** Generic Methods and Generic Classes. Interfaces (Set, List, Queue, and Dequeue) and classes (ArrayList, Vector, LinkedList, PriorityQueue, HashSet, LinkedHashSet, and TreeSet). **Serialization and Networking:** Serializing an Object and Deserializing an Object, Socket Programming. **Database Connectivity and Multithreading:** SQL, JDBC, Thread life cycle, Thread methods, Thread Pools, Executor Service. **GUI in JAVA:** AWT, Applet, Swing.

#### DATA SCIENCE WITH R

**Introduction to Data Science-** What is Data Science? Current landscape of perspectives, Skill sets needed, The Data Science Process life cycle, Role of Data Scientist. Data pre-processing. ETL – extract, transform, and load.

**Introduction to R-**What is R? Installation of R. Basic features of R. R Objects. Creating Vectors and Matrices. Getting Data in and out of R. Using different packages related to data science. Managing Data frames and Functions.

**Descriptive Statistics using R -** Discrete and continuous random variables, densities and distributions .Data Summarization: Measures of Central Tendency, Measures of Dispersion (quartiles, five number summary, variance, standard deviation), Measures of shape (skewness, kurtosis), Measures of association (covariance, correlation), Outliers. Using R for descriptive statistics and data visualization using ggplot2 package.

**Predictive Analysis using Machine Learning Techniques using R:** Machine learning - what, how, where. Supervised, unsupervised and semi-supervised learning. Training, validation, testing, generalization, over fitting. Building a Regression model using R.Features and feature engineering. Using Decision trees, Linear classifiers, Naïve Bayes, Nearest neighbor methods in R packages.

#### Books:

#### Text:

1. Java: The Complete Reference, Herbert Schildt, TMG Publication, ISBN 9780070636774 , 7th Edition
2. Java generics and collections, Thomas Powell, O'Reilly Media, ISBN: 0596527756, 2006.
3. Peng, Roger D., and Elizabeth Matsui. "The Art of Data Science." A Guide for Anyone Who Works with Data. Skybrude Consulting 200 (2015): 162.
4. Evans, James R., and Carl H. Lindner. "Business analytics: the next frontier for decision sciences." Decision Line 43.2 (2012): 4-6.

#### Reference:

1. JAVA EE 7 for Beginners, Sharanam Shah and Vaishali Shah, SPD, ISBN: 13:978-93-5110-349-3
2. Data Mining: Concepts and Techniques, Jiawei Han and Micheline Kamber, Morgan Kaufman, ISBN 978-81-312-0535-8, 2nd Edition.
3. Learning R, Richard Cotton, O'Reilly, ISBN: 13:978-93-5110-286-1, First Edition, Fourth Indian Reprint 2015

#### Suggested List of Laboratory Assignments for Advanced JAVA

- |    |   |
|----|---|
| 1. | Design a system with the help of advance data structures in Java and enhance the system using collections and generics. |
| 2. | Enhance the above system with the help of socket programming use client server architecture.                            |

3.	Enhance above system by using JDBC, Multithreading, concurrency, synchronous and asynchronous callbacks, ThreadPools using ExecutorService.
4.	Transform the above system from command line system to GUI based application
<b>Suggested List of Laboratory Assignments on Data Science with R</b>	
1.	Getting Started with R installation, R objects and basic statistics.
2.	Using R for data preprocessing, exploratory analysis, visualization.
3.	Using R for correlation and regression analysis.
4.	Data analysis case study using R for readily available data set using any one machine learning algorithm
<b>Suggested Mini Project on Advanced JAVA and Data Science with R</b>	
<ol style="list-style-type: none"> <li>1. Implementing a simple Recommender System based on user buying pattern.</li> <li>2. Applying linear regression model to a real world problem.</li> </ol>	
<b>SD Module-VI</b>	<b>Aptitude Development</b>
<b>Quantitative Aptitude, Logical Reasoning and Verbal Ability</b>	
<p>An aptitude is a component of a competence to do a certain kind of work at a certain level. Outstanding aptitude can be considered "talent". An aptitude may be physical or mental. Aptitude is inborn potential to do certain kinds of work whether developed or undeveloped. Ability is developed knowledge, understanding, learned or acquired abilities (skills) or attitude. The innate nature of aptitude is in contrast to skills and achievement, which represent knowledge or ability that is gained through learning. (Ref: <a href="https://en.wikipedia.org/wiki/Aptitude">https://en.wikipedia.org/wiki/Aptitude</a>).</p> <p>Aptitude and ability tests are designed to assess your logical reasoning or thinking performance. The statistics reveal that 70 percent of world's recruitment companies use aptitude test as a part of their recruitment procedure. These types of tests often permit potential companies to learn more about candidate's personality and abilities.</p> <p>It is well said that aptitude isn't really something one can easily improve, but surely practice can help to improve. Solving number of high level of questions will surely help to succeed while subsequent practices of solving same. Each attempt should aim to attain a level of efficiency. Practice of solving hundreds of similar questions helps to choose right approach to solve.</p>	
<p><b>It is recommended to conduct few expert talks and conduct practice tests for students for minimum 15 minutes per week in current semester and continue in semester VI, VII and VIII.</b></p>	
<b>Text:</b>	
<ol style="list-style-type: none"> <li>1. R.S Aggarwal, "Quantitative Aptitude", S Chand Publisher, ISBN- 9788121924986</li> <li>2. Aptipedia- Aptitude Encyclopedia, Wiley, ISBN:978-81-265-6223-7</li> <li>3. Shakuntala Devi, "Puzzles to Puzzle You" and "More Puzzles to Puzzle You", Orient Paperbacks, 2005. ISBN, 8122200141, 9788122200140</li> </ol>	

**Savitribai Phule Pune University**  
**Third Year of Computer Engineering (2015 Course)**  
**310247:Database Management System Lab**

<b>Teaching Scheme:</b> <b>Practical : 04 Hours/Week</b>	<b>Credit</b> <b>02</b>	<b>Examination Scheme:</b> <b>Practical: 50 Marks</b> <b>Term Work: 25 Marks</b>
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**Companion Course:** 310242 Database Management System

**Course Objectives:**

- To develop basic, intermediate and advanced Database programming skills
- To develop basic Database administration skills
- To percept transaction processing

**Course Outcomes:**

On completion of the course, student will be able to–

- Develop the ability to handle databases of varying complexities
- Use advanced database Programming concepts

**Guidelines for Instructor's Manual**

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

**Guidelines for Student Journal**

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Database design, test cases, conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory

**Guidelines for Assessment**

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

**Guidelines for Practical Examination**

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

**Guidelines for Laboratory Conduction**

The instructor is expected to frame the assignments by understanding the prerequisites,



technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

**Set of suggested assignment list is provided in groups- A and B. Each student must perform at least 13 assignments (8-Mandatory plus 4 from remaining 8 assignments) from group A , 5 from group B and 2 mini projects from Group C**

**Operating System recommended :-** 64-bit Open source Linux or its derivative

**Programming tools recommended:** SQL, PL/SQL, Front End: Java/Perl/PHP/Python/Ruby/.net, Backend : MongoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC

### Suggested List of Laboratory Assignments

#### Group A- Database Programming Languages – SQL, PL/SQL

1.	Study of Open Source Relational Databases : MySQL
2.	Design and Develop SQL DDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence, Synonym
3.	Design at least 10 SQL queries for suitable database application using SQL DML statements: Insert, Select, Update, Delete with operators, functions, and set operator.
4.	Design at least 10 SQL queries for suitable database application using SQL DML statements: all types of Join, Sub-Query and View.
5.	<p>Unnamed PL/SQL code block: Use of Control structure and Exception handling is mandatory. Write a PL/SQL block of code for the following requirements:-</p> <p>Schema:</p> <ol style="list-style-type: none"> <li>1. Borrower(Roll_no, Name, DateofIssue, NameofBook, Status)</li> <li>2. Fine(Roll_no,Date,Amt)</li> </ol> <ul style="list-style-type: none"> <li>• Accept roll_no &amp; name of book from user.</li> <li>• Check the number of days (from date of issue), if days are between 15 to 30 then fine amount will be Rs 5per day.</li> <li>• If no. of days&gt;30, per day fine will be Rs 50 per day &amp; for days less than 30, Rs. 5 per day.</li> <li>• After submitting the book, status will change from I to R.</li> <li>• If condition of fine is true, then details will be stored into fine table.</li> </ul> <p><b>Frame the problem statement for writing PL/SQL block inline with above statement.</b></p>
6.	<p>Cursors: (All types: Implicit, Explicit, Cursor FOR Loop, Parameterized Cursor)</p> <p>Write a PL/SQL block of code using parameterized Cursor, that will merge the data available in the newly created table N_RollCall with the data available in the table O_RollCall. If the data in the first table already exist in the second table then that data should be skipped.</p> <p><b>Frame the separate problem statement for writing PL/SQL block to implement all types of Cursors inline with above statement. The problem statement should clearly state the requirements.</b></p>
7.	<p>PL/SQL Stored Procedure and Stored Function.</p> <p>Write a Stored Procedure namely proc_Grade for the categorization of student.if marks scored by students in examination is &lt;=1500 and marks&gt;=990 then student will be placed in distinction category if marks scored are between 989 and900 category is first class, if marks 899 and 825 category is Higher Second Class</p> <p>Write a PL/SQL block for using procedure created with above requirement.</p>

	Stud_Marks(name, total_marks)          Result(Roll,Name, Class) <b>Frame the separate problem statement for writing PL/SQL Stored Procedure and function, inline with above statement. The problem statement should clearly state the requirements.</b>
8.	Database Trigger (All Types: Row level and Statement level triggers, Before and After Triggers). Write a database trigger on Library table. The System should keep track of the records that are being updated or deleted. The old value of updated or deleted records should be added in Library_Audit table. <b>Frame the problem statement for writing Database Triggers of all types, in-line with above statement. The problem statement should clearly state the requirements.</b>
<b>Group B Large Scale Databases</b>	
1.	Study of Open Source NOSQL Database: MongoDB (Installation, Basic CRUD operations, Execution)
2.	Design and Develop MongoDB Queries using CRUD operations. (Use CRUD operations, SAVE method, logical operators)
3.	Implement aggregation and indexing with suitable example using MongoDB.
4.	Implement Map reduces operation with suitable example using MongoDB.
5.	Design and Implement any 5 query using MongoDB
6.	Create simple objects and array objects using JSON
7.	Encode and Decode JSON Objects using Java/Perl/PHP/Python/Ruby
<b>Group C Mini Project : Database Project Life Cycle</b>	
1.	Write a program to implement MogoDB database connectivity with PHP/ python/Java Implement Database navigation operations (add, delete, edit etc. ) using ODBC/JDBC.
2.	Implement MYSQL/Oracle database connectivity with PHP/ python/Java Implement Database navigation operations (add, delete, edit,) using ODBC/JDBC.
3.	Using the database concepts covered in Part-I & Part-II & connectivity concepts covered in Part C, students in group are expected to design and develop database application with following details: <b>Requirement Gathering and Scope finalization</b> <b>Database Analysis and Design:</b> <ul style="list-style-type: none"> <li>Design Entity Relationship Model, Relational Model, Database Normalization</li> </ul> <b>Implementation :</b> <ul style="list-style-type: none"> <li>Front End : Java/Perl/PHP/Python/Ruby/.net</li> <li>Backend : MongoDB/MYSQL/Oracle</li> <li>Database Connectivity : ODBC/JDBC</li> </ul> <b>Testing : Data Validation</b> Group of students should submit the Project Report which will be consist of documentation related to different phases of Software Development Life Cycle: Title of the Project, Abstract, Introduction, scope, Requirements, Data Modeling features, Data Dictionary, Relational Database Design, Database Normalization, Graphical User Interface, Source Code, Testing document, Conclusion. Instructor should maintain progress report of mini project throughout the semester from project group and assign marks as a part of the term work
<b>Books:</b>	
1. Ivan Bayross, BPB Publication ,“SQL, PL/SQL: The Programming Language of Oracle” 2. Kristina Chodorow, Michael Dirolf, “MangoDB: The Definitive Guide”, O’Reilly Publications 3. <a href="http://www.tutorialspoint.com/json/">http://www.tutorialspoint.com/json/</a> & <a href="http://docs.mongodb.org/manual/">http://docs.mongodb.org/manual/</a> 4. Roger Pressman “Software Engineering: A Practitioner’s Approach”, McGraw-Hill ISBN:0073375977	

**Savitribai Phule Pune University**  
**Third Year of Computer Engineering (2015 Course)**  
**310248: Computer Networks Lab**

<b>Teaching Scheme:</b> <b>PR: 02 Hours/Week</b>	<b>Credit</b> <b>01</b>	<b>Examination Scheme:</b> <b>TW: 25 Marks</b> <b>PR: 50 Marks</b>
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**Companion Course: 310245 Computer Networks (CN)**

**Course Objectives:**

- To establish communication among the computing nodes in P2P and Client-Server architecture
- Configure the computing nodes with understanding of protocols and technologies.
- Use different communicating modes and standards for communication
- Use modern tools for network traffic analysis
- To learn network programming.

**Course Outcomes:**

On completion of the course, student will be able to–

- Demonstrate LAN and WAN protocol behavior using Modern Tools.
- Analyze data flow between peer to peer in an IP network using Application, Transport and Network Layer Protocols.
- Demonstrate basic configuration of switches and routers.
- Develop Client-Server architectures and prototypes by the means of correct standards and technology.

**Guidelines for Instructor's Manual**

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

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**Guidelines for Assessment**

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### Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

**Set of suggested assignment list is provided in groups- A and B. Each student must perform at least 8 assignments (4-Mandatory plus 4 from remaining 8 assignments) from group A and 4 from group B (2-Mandatory plus 2 from remaining 5 assignments).**

**Operating System recommended :-** 64-bit Open source Linux or its derivative

**Programming tools recommended:** - Open Source C,C++, JAVA, PYTHON,  
Programming tool like G++/GCC, Wireshark, Etheral and Packet Tracer

### Suggested List of Laboratory Assignments

#### Group A

**All assignments should be implemented using Open Source Linux flavors, Open Source Tools: Wireshark and Packet Tracer and C/C++, JAVA, PYTHON.**

- |    |  |
|----|--|
| 1. | <p><b>Lab Assignment on Unit I: (Mandatory Assignment)</b><br/> <b>Part A:</b> Setup a wired LAN using Layer 2 Switch and then IP switch of minimum four computers. It includes preparation of cable, testing of cable using line tester, configuration machine using IP addresses, testing using PING utility and demonstrate the PING packets captured traces using Wireshark Packet Analyzer Tool.<br/> <b>Part B:</b> Extend the same Assignment for Wireless using Access Point</p> |
| 2. | <p><b>Lab Assignment on Unit II: (Use C/C++)</b><br/>           Write a Program with following four options to transfer-<br/>           a. Characters separated by space                      b. One Strings at a time<br/>           b. One Sentence at a time                                      c. file<br/>           between two RS 232D or USB ports using C/C++. (To demonstrate Framing, Flow control, Error control).</p>   |
| 3. | <p><b>Lab Assignment on Unit II: (Use C/C++)</b><br/>           Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.( 50% students will perform Hamming Code and others will perform CRC)</p>   |
| 4. | <p><b>Lab Assignment on Unit II: (Use JAVA/PYTHON)</b><br/>           Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window</p>   |

	Protocol in peer to peer mode and demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
5.	<b>Lab Assignment on Unit IV: (Use JAVA/PYTHON)</b> Write a program to demonstrate subnetting and find the subnet masks.
6.	<b>Lab Assignment on Unit IV: (Use JAVA/PYTHON)</b> Write a program to simulate the behaviour of link state routing protocol to find suitable path for transmission.
7.	<b>Lab Assignment on Unit V: (Mandatory Assignment) (Use C/C++)</b> Write a program using TCP socket for wired network for following <ul style="list-style-type: none"> <li>a. Say Hello to Each other ( For all students)</li> <li>b. File transfer ( For all students)</li> <li>c. Calculator (Arithmetic) (50% students)</li> <li>d. Calculator (Trigonometry) (50% students)</li> </ul> Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
8.	<b>Lab Assignment on Unit V: (Mandatory Assignment) (Use C/C++)</b> Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
9.	<b>Lab Assignment on Unit V: (Mandatory Assignment) (Use C/C++)</b> Write a program to analyze following packet formats captured through Wireshark for wired network. 1. Ethernet 2. IP 3. TCP 4. UDP
10.	Write a program to simulate the behavior of Slow Start and AIMD (Additive Increase and Multiplicative Decrease) congestion control protocols. <b>(Use JAVA/PYTHON)</b>
11.	<b>Lab Assignment on Unit VI: (Use JAVA/PYTHON)</b> Write a program for DNS lookup. Given an IP address input, it should return URL and vice-versa.
12.	<b>Lab Assignment on Unit VI:</b> Installing and configure DHCP server and write a program to install the software on remote machine.
<b>Group B</b>	
1.	<b>Lab Assignment on Unit II: (Use JAVA/PYTHON)</b> Write a Program to transfer- By using Bluetooth <ul style="list-style-type: none"> <li>a. Characters separated by space</li> <li>b. One Strings at a time</li> <li>c. One Sentence at a time</li> <li>d. File</li> </ul>
2.	<b>Lab Assignment on Unit IV: (Use JAVA/PYTHON)</b> Study of any network simulation tools - To create a network with three nodes and establish a TCP connection between node 0 and node 1 such that node 0 will send TCP packet to node 2 via node 1
3.	<b>Lab Assignment on Unit V: (Use JAVA/PYTHON)</b> Write a program using TCP sockets for wired network to implement <ul style="list-style-type: none"> <li>a. Peer to Peer Chat</li> <li>b. Multiuser Chat</li> </ul> Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
4.	<b>Lab Assignment on Unit V: (Use JAVA/PYTHON)</b> Write a program using UDP sockets for wired network to implement <ul style="list-style-type: none"> <li>a. Peer to Peer Chat</li> <li>b. Multiuser Chat</li> </ul> Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to

	peer mode.
5.	<b>Lab Assignment on Unit V: (Use JAVA/PYTHON)</b> Write a program to prepare TCP and UDP packets using header files and send the packets to destination machine in peer to peer mode. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
6.	<b>Lab Assignment on Unit IV and Unit V: (Mandatory Assignment)</b> Use network simulator NS2 to implement: a. Monitoring traffic for the given topology b. Analysis of CSMA and Ethernet protocols c. Network Routing: Shortest path routing, AODV. d. Analysis of congestion control (TCP and UDP).
7.	<b>Lab Assignment on Unit IV: (Mandatory Assignment)</b> Configure RIP/OSPF/BGP using packet Tracer.



**Savitribai Phule Pune University**  
**Third Year of Computer Engineering (2015 Course)**  
**310249: Audit Course 3**

In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement their knowledge and skills. Student will be awarded the bachelor's degree if he/she earns 190 credits and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

**Criteria:**

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. (Ref- [http://www.unipune.ac.in/Syllabi\\_PDF/revise-2015/engineering/UG\\_RULE\\_REGULATIONS\\_FOR\\_CREDIT\\_SYSTEM-2015\\_18June.pdf](http://www.unipune.ac.in/Syllabi_PDF/revise-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf))

**Guidelines for Conduction and Assessment (Any one or more of following but not limited to)**

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• Lectures/ Guest Lectures</li> <li>• Visits (Social/Field) and reports</li> <li>• Demonstrations</li> </ul> | <ul style="list-style-type: none"> <li>• Surveys</li> <li>• Mini Project</li> <li>• Hands on experience on specific focused topic</li> </ul> |
|---|--|

**Guidelines for Assessment (Any one or more of following but not limited to)**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>• Written Test</li> <li>• Demonstrations/ Practical Test</li> <li>• Presentations</li> </ul> | <ul style="list-style-type: none"> <li>• IPR/Publication</li> <li>• Report</li> </ul> |
|---|---|

**Audit Course 3 Options**

AC3- I	Cyber Security
AC3-II	Professional Ethics and Etiquettes
AC3-III	Emotional Intelligence
AC3-IV	MOOC-Learn New Skills
AC3-V	Foreign Language (one of Japanese/ Spanish/French/German). Course contents for <b>Japanese (Module 3) are provided. For other languages institute may design suitably.</b>

Note: It is permitted to opt one of the audit courses listed at SPPU website too.

<http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx>

**Savitribai Phule Pune University, Pune**  
**Third Year of Computer Engineering (2017 Course)**  
**310249: Audit Course 3**  
**AC3 – I: Cyber Security**

Effective information security at the enterprise level requires participation, planning, and practice. It is an ongoing effort that requires management and staff to work together from the same script. Fortunately, the information security community has developed a variety of resources, methods, and best practices to help modern enterprises address the challenge. Unfortunately, employing these tools demands a high degree of commitment, understanding, and skill attributes that must be sustained through constant awareness and training.

**Course Objectives:**

- To assess the current security landscape, including the nature of the threat, the general status of common vulnerabilities, and the likely consequences of security failures;
- To critique and assess the strengths and weaknesses of general cyber security models, including the CIA triad
- To appraise the interrelationships among elements that comprise a modern security system, including hardware, software, policies, and people;
- To assess how all domains of security interact to achieve effective system-wide security at the enterprise level.

**Course Outcome:**

On completion of the course, learner will be able to—

- Compare the interrelationships among security roles and responsibilities in a modern information-driven enterprise—to include interrelationships across security domains (IT, physical, classification, personnel, and so on)
- Assess the role of strategy and policy in determining the success of information security;
- Estimate the possible consequences of misaligning enterprise strategy, security policy, and security plans;

**Course Contents:**

- 1. Cyber Security Basics:** Introduction, Elements of Information security, Security Policy, Techniques, Operational Model of Network Security, Terminologies in Network Security
- 2. Introduction to Cryptography:** Introduction, Encryption Methods: Symmetric, Asymmetric, Public Key and Management, Authentication methods, Digital Signatures
- 3. Security requirements:** Electronic Mail Security: Pretty Good Privacy, MIME, S/MIME, And Comparison. WEB Security, Secure Electronic Transaction(SET).
- 4. Intrusion and Firewall:** Introduction to threats, Intrusion detection, IDS: Need, Methods, Types of IDS, Password Management, Limitations and Challenges, Firewall Introduction, Characteristics and types, Benefits and limitations. Firewall architecture, Trusted Systems, Access Control
- 5. Security perspective of Hacking and its counter majors :** Introduction to Hacking, Counter majors: General Strategies

**Books:**

1. William Stallings, “Cryptography and Network Security”, Pearson, ISBN:978-93-325-1877-3



**Savitribai Phule Pune University, Pune**  
**Third Year of Computer Engineering (2017 Course)**  
**310249: Audit Course 3**  
**AC3 – II: Professional Ethics and Etiquettes**

Professional ethics is the underlying concept behind the successful accomplishment of any act of a professional towards achieving the individual and societal goals. These goals should ultimately result in morally, legally, ethically and even culturally acceptable good things for all. Engineers being special group of professionals need to be more conscious of their acts since their duties, rights and responsibilities permeate into the society and the surroundings. To practice professional ethics, understanding of values and concepts are essential.

**Course Objectives:**

- To create awareness on professional ethics and Human Values.
- To provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards.
- To inculcate knowledge and exposure on Safety and Risk.
- To expose students to right attitudinal and behavioral aspects

**Course Outcome:**

On completion of the course, learner will be able to–

- understand the basic perception of profession, professional ethics, various moral issues & uses of ethical theories
- understand various social issues, industrial standards, code of ethics and role of professional ethics in engineering field.
- follow Ethics as an engineering professional and adopt good standards & norms of engineering practice.
- apply ethical principles to resolve situations that arise in their professional lives

**Course Contents:**

- 1. Human Values And Engineering Ethics:** Morals, values and Ethics, Integrity, Work ethic, Civic virtue , Valuing time, Cooperation, Commitment, Empathy, Self-confidence , stress management, Senses of Engineering Ethics, Kohlberg’s theory, Gilligan’s theory, Models of professional roles, Uses of Ethical Theories.
- 2. Research Ethics and Codes of Ethics:** Industrial standardization, ethical code and its importance, ethical accountability, law in engineering, engineering as social experimentation.
- 3. Safety, Responsibilities And Rights:** Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk collegiality, Collective Bargaining , Confidentiality , Conflicts of Interest, Professional Rights, Employee Rights, Intellectual Property Rights (IPR), Discrimination, Utilitarianism
- 4. Professional Etiquette:** Etiquette at Meetings, Public Relations Office(PRO)’s Etiquettes, Technology Etiquette Phone Etiquette, Email Etiquette, Social Media Etiquette, Video Conferencing Etiquette, Interview Etiquette, Dressing Etiquettes : for Interview, offices and social functions, Ethical Values: Importance of Work Ethics.

**Books:**

1. Caroline Whitbeck, “Ethics in Engineering Practice and Research”, Cambridge Press, ISBN:978-1-107-66847-8
2. Prabhuddha Ganguli: —Intellectual Property Rights| Tata Mc-Graw –Hill, New Delhi, ISBN-10:0070077177
3. Professional Ethics and Etiquette (Mastering Career Skills), Checkmark, ISBN-10: 0816071179
4. A Alavudeen, ”Professional Ethics And Human Values” Firewall, ISBN13 : 8131803066

**Savitribai Phule Pune University, Pune**  
**Third Year of Computer Engineering (2017 Course)**  
**310249: Audit Course 3**  
**AC3 – III: Emotional Intelligence**

This Emotional Intelligence (EI) training course will focus on the five core competencies of emotional intelligence: self-awareness, self-regulation, motivation, empathy and interpersonal skills. Participants will learn to develop and implement these to enhance their relationships in work and life by increasing their understanding of social and emotional behaviors, and learning how to adapt and manage their responses to particular situations. Various models of emotional intelligence will be covered

**Course Objectives:**

- To develop an awareness of EI models
- To recognize the benefits of EI
- To understand how you use emotion to facilitate thought and behavior
- To know and utilize the difference between reaction and considered response

**Course Outcomes:**

On completion of the course, learner will be able to–

- Expand your knowledge of emotional patterns in yourself and others
- Discover how you can manage your emotions, and positively influence yourself and others
- Build more effective relationships with people at work and at home
- Positively influence and motivate colleagues, team members, managers
- Increase your leadership effectiveness by creating an atmosphere that engages others
- EI behaviors and supports high performance

**Course Contents:**

- 1. Introduction to Emotional Intelligence (EI) :** Emotional Intelligence and various EI models, The EQ competencies of self-awareness, self-regulation, motivation, empathy, and interpersonal skills ,Understand EQ and its importance in life and the workplace
- 2. Know and manage your emotions:** What are emotions? ,The different levels of emotional awareness ,Increase your emotional knowledge of yourself ,Recognize ‘negative’ and ‘positive’ emotions. The relationship between emotions, thought and behavior, Discover the importance of values, The impact of not managing and processing ‘negative’ emotions, Techniques to manage your emotions in challenging situations
- 3. Recognize emotions in others :** The universality of emotional expression, Learn tools to enhance your ability to recognize and appropriately respond to others' emotions, Perceiving emotions accurately in others to build empathy
- 4. Relate to others :** Applying EI in the workplace, The role of empathy and trust in relationships, Increase your ability to create effective working relationships with others (peers, subordinates, managers, clients, Find out how to deal with conflict ,Tools to lead, motivate others and create a high performing team

**Books:**

- Daniel Goleman,” Emotional Intelligence – Why It Matters More Than IQ,”
- Steven Stein , “The EQ Edge”
- Drew Bird , “[The Leader’s Guide to Emotional Intelligence](#)”

**Savitribai Phule Pune University, Pune**  
**Third Year of Computer Engineering (2017 Course)**  
**310249: Audit Course 3**  
**AC3 – IV: MOOC-learn New Skill**

**Course Objectives:**

- To promote interactive user forums to support community interactions among students, professors, and experts
- To promote learn additional skills anytime and anywhere
- To enhance teaching and learning on campus and online

**Course Outcome:**

On completion of the course, learner will acquire additional knowledge and skill.

**Course Contents:**

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. Whether you're interested in learning for yourself, advancing your career or leveraging online courses to educate your workforce, SWYAM, NPTEL, edx or similar ones can help.

World's largest SWAYAM MOOCs, a new paradigm of education for anyone, anywhere, anytime, as per your convenience, aimed to provide digital education free of cost and to facilitate hosting of all the interactive courses prepared by the best more than 1000 specially chosen faculty and teachers in the country. SWAYAM MOOCs enhances active learning for improving lifelong learning skills by providing easy access to global resources.

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to the residents in India. More than 1,000 specially chosen faculty and teachers from across the Country have participated in preparing these courses.

The courses hosted on SWAYAM will be in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology. In order to ensure best quality content are produced and delivered, seven National Coordinators have been appointed: They are NPTEL for engineering and UGC for post-graduation education.

**References:**

1. <https://swayam.gov.in/>
2. <https://onlinecourses.nptel.ac.in/>
3. <https://www.edx.org>

**Savitribai Phule Pune University, Pune**  
**Third Year of Computer Engineering (2017 Course)**  
**310249: Audit Course 3**  
**AC3 – V: Foreign Language(Japanese Module 3)**

**About Course:**

With changing times, the competitiveness has gotten into the nerves and ‘Being the Best’ at all times is only the proof of it. Nonetheless, ‘being the best’ differs significantly from ‘Communicating the best’. The best can merely be communicated whilst using the best suited Language!

Japanese is the new trend of 21st century. Not only youngsters but even the professionals seek value in it. It is the engineer’s companion in current times with an assertion of a thriving future. Pune has indisputably grown to become a major center of Japanese Education in India while increasing the precedence for Japanese connoisseurs.

Japanese certainly serves a great platform to unlock a notoriously tough market & find a booming career. While the companies prefer candidates having the knowledge of the language, it can additionally help connect better with the native people thus prospering in their professional journey. Learning Japanese gives an extra edge to the ‘resume’ since the recruiters consciously make note of the fact it requires real perseverance and self-discipline to tackle one of the most complex languages.

It would be easy for all time to quit the impossible; however it takes immense courage to reiterate the desired outcomes, recognize that improvement is an ongoing process and ultimately soldier on it. The need of an hour is to introduce Japanese language with utmost professionalism to create awareness about the bright prospects and to enhance the proficiency and commitment. It will then prove to be the ultimate path to the quest for professional excellence!

**Course Objectives:**

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

**Course Outcome:**

On completion of the course, learner will be able to–

- Have ability of basic communication.
- Have the knowledge of Japanese script.
- Get introduced to reading, writing and listening skills for language Japanese.
- Develop interest to pursue professional Japanese Language course

**Course Contents:**

1. Introduction to Kanji Script, Describing one’s daily routine. To ask what someone does. Expressions of Giving & Receiving.
2. Adjectives (Types of adjectives), Asking impression or an opinion about a thing / person / place that the listener, Has experienced, visited, or met, Describing things / person / places with the help of the adjectives.
3. Expressions of Like & Dislikes. Expressing one’s ability, hobby, Comparison between objects, persons & cities, which resulted from a certain action in the past.

**References:**

1. Minna No Nihongo, —Japanese for Everyone!, Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.
2. <http://www.tcs.com> ([http://www.tcs.com/news\\_events/press\\_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx](http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx))

# SEMESTER II

<b>Savitribai Phule Pune University</b> <b>Third Year of Computer Engineering (2015 Course)</b> <b>310250: Design and Analysis of Algorithms</b>		
<b>Teaching Scheme:</b> TH: 04 Hours/Week	<b>Credit</b>  04	<b>Examination Scheme:</b> <b>In-Sem (Paper): 30 Marks</b> <b>End-Sem (Paper): 70 Marks</b>
<b>Prerequisite: Discrete Mathematics, Data Structures</b>		
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• To develop problem solving abilities using mathematical theories</li> <li>• To analyze the performance of algorithms</li> <li>• To study algorithmic design strategies</li> </ul>		
<b>Course Outcomes:</b> On completion of the course, student will be able to– <ul style="list-style-type: none"> <li>• Formulate the problem</li> <li>• Analyze the asymptotic performance of algorithms</li> <li>• Decide and apply algorithmic strategies to solve given problem</li> <li>• Find optimal solution by applying various methods</li> </ul>		
<b>Course Contents</b>		
<b>Unit I</b>	<b>Fundamentals</b>	<b>09 Hours</b>
The Role of Algorithms in Computing - What are algorithms, Algorithms as technology, Evolution of Algorithms, Design of Algorithm, Need of Correctness of Algorithm, Confirming correctness of Algorithm – sample examples, Iterative algorithm design issues		
<b>Unit II</b>	<b>Models and Design</b>	<b>09 Hours</b>
Functional Model – Features, Recursive processes, Scope rules, Tail recursion, Checking correctness of Iterative process. Imperative Model – Basics, Specifications and Prototyping, Stepwise Refinement, Proof Rules – Basics, For loops, Goto and Exit loops, Functions and Procedures, Problem Solving using Greedy strategy - Knapsack problem, Huffman code generation algorithm		
<b>Unit III</b>	<b>Abstract Algorithms</b>	<b>09 Hours</b>
Dynamic Programming, Divide and Conquer, Greedy strategy, Branch-n-Bound, Natural Algorithms –Evolutionary Algorithms and Evolutionary Computing, Introduction to Genetic Algorithm, Simulated Annealing, Artificial Neural Network and Tabu Search.		
<b>Unit IV</b>	<b>Complexity Theory</b>	<b>09 Hours</b>
Complexity theory – Counting Dominant operators, Growth rate, upper bounds, asymptotic growth, $O$ , $\Omega$ , $\Theta$ , $o$ and $\omega$ notations, polynomial and non-polynomial problems, deterministic and non-deterministic algorithms, P-class problems, NP-class of problems, Polynomial problem reduction NP complete problems- vertex cover and 3-SAT and NP hard problem - Hamiltonian cycle		
<b>Unit V</b>	<b>Amortized Analysis</b>	<b>09 Hours</b>
Amortized Analysis – Binary, binomial and Fibonacci heaps, Dijkstra’s Shortest path algorithm, Splay Trees, Time-Space tradeoff, Introduction to Tractable and Non-tractable Problems, Introduction to Randomized and Approximate algorithms, Embedded Algorithms: Embedded system scheduling (power optimized scheduling algorithm), sorting algorithm for embedded systems.		

Unit VI	Multithreaded and Distributed Algorithms	09 Hours
<p>Multithreaded Algorithms - Introduction, Performance measures, Analyzing multithreaded algorithms, Parallel loops, Race conditions.</p> <p>Problem Solving using Multithreaded Algorithms - Multithreaded matrix multiplication, Multithreaded merge sort.</p> <p>Distributed algorithms - Introduction, Distributed breadth first search, Distributed Minimum Spanning Tree.</p> <p>String Matching- Introduction, The naive string matching algorithm, The Rabin-Karp algorithm</p>		
<p><b>Books:</b></p>		
<p><b>Text:</b></p> <ol style="list-style-type: none"> <li>1. Parag Himanshu Dave, Himanshu Bhalchandra Dave, “ Design And Analysis Of Algorithms”, PEARSON Education, ISBN 81-7758-595-9</li> <li>2. Gilles Brassard, Paul Bratley, Fundamentals of Algorithmics, PHI, ISBN 978-81-203-1131-2</li> </ol>		
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Michael T. Goodrich, Roberto Tamassia , Algorithm Design: Foundations, Analysis and Internet Examples, Wiley, ISBN 978-81-265-0986-7</li> <li>2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, MIT Press; ISBN 978-0-262-03384-8</li> <li>3. Horowitz and Sahani, "Fundamentals of Computer Algorithms", 2ND Edition. University Press, ISBN: 978 81 7371 6126, 81 7371 61262</li> <li>4. Rajeev Motwani and Prabhakar Raghavan, “Randomized Algorithms”, Cambridge University Press, ISBN: 978-0-521-61390-3</li> <li>5. Dan Gusfield, “Algorithms on Strings, Trees and Sequences”, Cambridge University Press, ISBN:0-521-67035-7</li> </ol>		



<b>Savitribai Phule Pune University</b> <b>Third Year of Computer Engineering (2015 Course)</b> <b>310251: Systems Programming and Operating System</b>		
<b>Teaching Scheme:</b> TH: 04 Hours/Week	<b>Credit</b>  04	<b>Examination Scheme:</b> <b>In-Sem (Paper): 30 Marks</b> <b>End-Sem (Paper): 70 Marks</b>
<b>Prerequisite: Fundamentals of Programming Languages, Data Structures</b>		
<b>Companion Course: 210256 –Systems Programming and Operating System Lab</b>		
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• To understand basics of System Programming.</li> <li>• To learn and understand data structures used in design of system software.</li> <li>• To learn and understand basics of compilers and tools.</li> <li>• To understand functions of operating system.</li> <li>• To learn and understand process, resource and memory management.</li> </ul>		
<b>Course Outcomes:</b> On completion of the course, student will be able to– <ul style="list-style-type: none"> <li>• Analyze and synthesize system software</li> <li>• Use tools like LEX &amp; YACC.</li> <li>• Implement operating system functions.</li> </ul>		
<b>Course Contents</b>		
<b>Unit I</b>	<b>Introduction</b>	<b>09 Hours</b>
Introduction: Components of System Software: Text editors, Loaders, Assemblers, Macro processors, Compilers, Debuggers. Machine Structure, Machine language and Assembly Language. Assemblers: General design procedure, design of two pass assembler		
<b>Unit II</b>	<b>Macro Processor, Linker and Loader</b>	<b>09 Hours</b>
Macro Processor: Macro instructions, Features of macro facility, Design of two-pass, single pass and nested macro processor. Loaders: Loader schemes: Compile and go, General Loader Scheme, Absolute loaders, subroutine linkages, relocating loaders, direct linking loaders, overlay structure. Design of an absolute loader, Design of direct linking loader. Linkers: Relocation and linking concepts, Design of linker, self relocating programs, Static and dynamic link libraries, use of call back functions. Case Study: Loading phases using Java.		
<b>Unit III</b>	<b>Language Translator</b>	<b>09 Hours</b>
Role of lexical analysis -parsing & Token, patterns and Lexemes & Lexical Errors, regular definitions for the language constructs & strings, sequences, Comments & Transition diagram for recognition of tokens, reserved words and identifiers, examples Introduction to Compilers and Interpreters: General Model of Compiler, Program interpretation, Comparison of compiler and Interpreter, Use of Interpreter and components of Interpreter. Case Study: Overview of LEX and YACC specification and features.		
<b>Unit IV</b>	<b>Operating Systems</b>	<b>09 Hours</b>



Operating Systems: Introduction to different types of operating Real Time Operating Systems, System Components, OS services, System structure- Layered Approach.

Process Management: Process Concept- Process states, Process control block, Threads, Process Scheduling: Types of process schedulers, Types of scheduling: Preemptive, Non preemptive. Scheduling algorithms: FCFS, SJF, RR, Priority,

Deadlocks: Methods of handling deadlocks, Deadlock prevention, avoidance and detection, Recovery from deadlocks.

<b>Unit V</b>	<b>Memory Management</b>	<b>09 Hours</b>
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Memory management: Contiguous and non-contiguous, Swapping, Paging, Segmentation, Segmentation with Paging. Virtual Memory: Background, Demand paging, Page replacement scheme- FIFO, LRU, Optimal, Thrashing.

<b>Unit VI</b>	<b>I/O Management</b>	<b>09 Hours</b>
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I/O Management: I/O Devices, Organization of I/O function, I/O Buffering, Disk Scheduling- Disk Scheduling policies like FIFO, LIFO, STTF, SCAN, C-SCAN.

File Management: Concept, Access methods, Directory Structure, Protection, File System implementation, Directory Implementation, Allocation methods, Free Space management.

Case Study: Light weight and heavy weight OS: Linux, Tizen

**Books:**

**Text:**

1. John Donovan, "System Programming", McGraw Hill, ISBN 978-0--07-460482-3.
2. Silberschatz, Galvin, Gagne, "Operating System Principles", 9<sup>th</sup> Edition, Wiley, ISBN 978-1-118-06333-0

**References:**

1. Dhamdhere D., "Systems Programming and Operating Systems", 2<sup>nd</sup> Edition, ' McGraw Hill, 1999, ISBN 0 - 07 - 463579 – 4
2. by Randal Bryant and David O'Hallaron , "Computer Systems: A Programmer's Perspective" , Pearson, ISBN 10: 0-13-610804-0
3. Stallings W., "Operating Systems", 6th Edition, Prentice Hall, ISBN-978-81-317-2528-3.
4. John. R. Levine, Tony Mason and Doug Brown, Lex and Yacc, O'Reilly, 1998, ISBN: 1-56592-000-7

<b>Savitribai Phule Pune University</b> <b>Third Year of Computer Engineering (2015 Course)</b> <b>310252: Embedded Systems and Internet of Things</b>		
<b>Teaching Scheme:</b> TH: 04 Hours/Week	<b>Credit</b>  04	<b>Examination Scheme:</b> <b>In-Sem (Paper): 30 Marks</b> <b>End-Sem (paper): 70 Marks</b>
<b>Prerequisite:- Data Communication Network , Computer Network</b>		
<b>Companion Course: 210258 –Embedded Systems and IoT Lab</b>		
<b>Course Objectives:</b>		
<ul style="list-style-type: none"> <li>• To understand fundamentals of IoT and embedded system including essence, basic design strategy and process modeling.</li> <li>• To introduce students a set of advanced topics in embedded IoT and lead them to understand research in network.</li> <li>• To develop comprehensive approach towards building small low cost embedded IoT system.</li> <li>• To understand fundamentals of security in IoT,</li> <li>• To learn to implement secure infrastructure for IoT</li> <li>• To learn real world application scenarios of IoT along with its societal and economic impact using case studies</li> </ul>		
<b>Course Outcomes:</b>		
On completion of the course, student will be able to–		
<ul style="list-style-type: none"> <li>• Implement an architectural design for IoT for specified requirement</li> <li>• Solve the given societal challenge using IoT</li> <li>• Choose between available technologies and devices for stated IoT challenge</li> </ul>		
<b>Course Contents</b>		
<b>Unit I</b>	<b>Introduction to Embedded System and Internet of Things</b>	<b>08 Hours</b>
Embedded Systems: Application Domain and Characteristic of Embedded System, Real time systems and Real time scheduling, Processor basics and System-On-Chip, Introduction to ARM processor and its architecture. <b>IoT:</b> Definition and characteristics of IoT, Internet of Things: Vision, Emerging Trends, Economic Significance, Technical Building Blocks, Physical design of IoT, Things of IoT, IoT Protocols, Logical design of IoT, IoT functional blocks, IoT communication models, IoT Communication APIs, IoT enabling technologies, IoT levels and deployment templates, IoT Issues and Challenges, Applications		
<b>Unit II</b>	<b>Embedded IoT Platform Design Methodology</b>	<b>08 Hours</b>
Purpose and requirement specification, Process specification, Domain model specification, information model specification, Service specifications, IoT level specification, Functional view specification, Operational view specification, Device and component integration, Application development		
<b>Unit III</b>	<b>Pillars of Embedded IoT and Physical Devices</b>	<b>08 Hours</b>
Horizontal, verticals and four pillars of IoT, M2M: The internet of devices, RFID: The internet of objects, WSN: The internet of transducer, SCADA: The internet of controllers, DCM: Device, Connect and Manage, Device: Things that talk, Connect: Pervasive Network, Mangae: To create business values. IoT Physical Devices and Endpoints: Basic building blocks of and IoT device, Exemplary device: Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python, Other IoT Devices.		

Unit IV	IoT Protocols and Security	08 Hours
<p>Protocol Standardization for IoT, Efforts, M2M and WSN Protocols, SCADA and RFID Protocols, Issues with IoT Standardization, Unified Data Standards, Protocols – IEEE 802.15.4, BACNet Protocol, Modbus, KNX, Zigbee Architecture, Network layer, APS layer.</p> <p>IoT Security: Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling, Key elements of IoT Security: Identity establishment, Access control, Data and message security, Non-repudiation and availability, Security model for IoT.</p>		
Unit V	Web of Things and Cloud of Things	08 Hours
<p>Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Unified Multitier WoT Architecture, WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing, Cloud Middleware, Cloud Standards – Cloud Providers and Systems, Mobile Cloud Computing, The Cloud of Things Architecture</p>		
Unit VI	IoT Physical Servers, Cloud Offerings and IoT Case Studies	08 Hours
<p>Introduction to Cloud Storage Models, Communication API, WAMP: AutoBahn for IoT, Xively Cloud for IoT, Python Web Application Framework: Django, Amzon Web Services for IoT, SkyNet IoT Messaging Platform. Case Studies: Home Intrusion Detection, Weather Monitoring System, Air Pollution Monitoring, Smart Irrigation.</p>		
<p><b>Books:</b></p>		
<p><b>Text:</b></p> <ol style="list-style-type: none"> <li>1. Arshdeep Bahga, Vijay Madiseti, “Internet of Things – A hands-on approach”, Universities Press, 2015. ISBN</li> <li>2. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012. ISBN</li> <li>3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things”, Springer, 2011. ISBN</li> <li>4. Lyla B. Das, “Embedded Systems: An Integrated Approach” Pearson , ISBN</li> </ol>		
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. David Easley and Jon Kleinberg, “Networks, Crowds, and Markets: Reasoning About a Highly Connected World”, Cambridge University Press, 2010.</li> <li>2. Olivier Hersent, Omar Elloumi and David Boswarthick, “The Internet of Things: Applications to the Smart Grid and Building Automation”, Wiley, 2012.</li> <li>3. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.</li> <li>4. Barrie Sosinsky, “Cloud Computing Bible”, Wiley-India, 2010.</li> <li>5. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley, 2014.</li> <li>6. Christopher Hallinan, “Embedded Linux Primer”, Prentice Hall</li> </ol>		

**Savitribai Phule Pune University**  
**Third Year of Computer Engineering (2015 Course)**  
**310253: Software Modeling and Design**

<b>Teaching Scheme:</b> <b>TH: 03 Hours/Week</b>	<b>Credits</b> <b>03</b>	<b>Examination Scheme:</b> <b>In-Sem (Paper): 30 Marks</b> <b>End-Sem (Paper): 70 Marks</b>
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**Prerequisite: Software Engineering and Project Management**

**Course Objectives:**

- To understand and apply Object Oriented(OO) concept for designing OO based model/application
- To transform Requirement document to Appropriate design
- To understand different architectural designs and to transform them into proper model
- To choose and use modern design tools for project development and implementation.
- To choose and use appropriate test tool for testing web-based/desktop application

**Course Outcomes:**

On completion of the course, student will be able to–

- Analyze the problem statement (SRS) and choose proper design technique for designing web-based/ desktop application
- Design and analyze an application using UML modeling as fundamental tool
- Apply design patterns to understand reusability in OO design
- Decide and apply appropriate modern tool for designing and modeling
- Decide and apply appropriate modern testing tool for testing web-based/desktop application

**Course Contents**

<b>Unit I</b>	<b>Introduction</b>	<b>07 Hours</b>
Introduction to software design, design methods- procedural / structural and object oriented, Requirement Vs Analysis Vs Architecture Vs Design Vs Development 4+1 Architecture, case study of transferring requirement to design, UP, COMET use case based software life cycle, Introduction to UML -Basic building blocks, Reusability, Use case modeling, Use case template <b>Case study</b> – Transferring requirements into design using advanced tool		
<b>Unit II</b>	<b>Static Modelling</b>	<b>08 Hours</b>
Analysis Vs Design, Class diagram- Analysis - Object & classes finding analysis & Design- design classes, refining analysis relationships, Inheritance & polymorphism, Object diagram, Component diagram- Interfaces & components, deployment diagram, Package diagram		
<b>Unit III</b>	<b>Dynamic Modelling</b>	<b>07 Hours</b>
Interaction & Interaction overview diagram, sequence diagram, Timing diagram, Communication diagram, Advanced state machine diagram, Activity diagram		
<b>Unit IV</b>	<b>Architecture Design</b>	<b>08 Hours</b>
Introduction to Architectural design, overview of software architecture, Object oriented software architecture, Client server Architecture, Service oriented Architecture, Component based Architecture, Real time software Architecture		

<b>Unit V</b>	<b>Design patterns</b>	<b>07 Hours</b>
Introduction to Creational design pattern – singleton, Factory ,Structural design pattern- Proxy design pattern, Adapter design pattern, Behavioral – Iterator design pattern, Observer design pattern		
<b>Unit VI</b>	<b>Testing</b>	<b>08 Hours</b>
Introduction to testing, Error, Faults, Failures, verification and validation, Whit Box Testing, Black Box Testing, Unit testing, Integration testing, GUI testing, User acceptance Validation testing, integration testing, scenario testing, performance testing. Test cases and test plan. Case studies expected for developing usability test plans and test cases.		
Note: Instructor should frame appropriate case studies/ mini-project (different case study for a group of 6-8 students) on unit-I to unit-V. The case study framed for unit-I may be continued/carry forward for next units if necessary. The same case studies/mini-projects should be tested using appropriate testing tool (preferably open source like Selenium).		
<b>Books:</b>		
<b>Text Books:</b>		
<ol style="list-style-type: none"> <li>1. Jim Arlow, Ila Neustadt,“UML 2 and the unified process –practical object-oriented analysis and design” Addison Wesley, Second edition, ISBN 978-0201770605</li> <li>2. Hassan Gomaa, “Software Modeling and Design- UML, Use cases, Patterns and Software Architectures” Cambridge University Press, 2011, ISBN 978-0-521-76414-8</li> <li>3. Srinivasan Desikan, Gopalaswamy Ramesh, “Software testing- Principles and practices” Prentice Hall, 2007, ISBN 9788177581218</li> </ol>		
<b>References Books:</b>		
<ol style="list-style-type: none"> <li>1. Eric J. Braude, “Software Design: from Programming to Architecture”, J. Wiley, 2004, ISBN 978-0-471-20459-6</li> <li>2. Gardy Booch, James Rumbaugh, Ivar Jacobson, “The unified modeling language user guide” Pearson Education, Second edition, 2008, ISBN 0-321-24562-8</li> </ol>		

<b>Savitribai Phule Pune University</b> <b>Third Year of Computer Engineering (2015 Course)</b> <b>310254: Web Technology</b>		
<b>Teaching Scheme:</b> TH: 03 Hours/Week	<b>Credit</b> 03	<b>Examination Scheme:</b> <b>In-Sem (Paper): 30 Marks</b> <b>End-Sem (Paper): 70 Marks</b>
<b>Prerequisite:</b> Computer Network , Database Management Systems		
<b>Companion Course:</b> 210256 -Web Technology Lab		
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• To understand the principles and methodologies of web based applications development process</li> <li>• To understand current client side and server side web technologies</li> <li>• To understand current client side and server side frameworks</li> <li>• To understand web services and content management</li> </ul>		
<b>Course Outcomes:</b> On completion of the course, student will be able to– <ul style="list-style-type: none"> <li>• analyze given assignment to select sustainable web development design methodology</li> <li>• develop web based application using suitable client side and server side web technologies</li> <li>• develop solution to complex problems using appropriate method, technologies, frameworks, web services and content management</li> </ul>		
<b>Course Contents</b>		
<b>Unit I</b>	<b>Web Development Process, Front End Tools</b>	<b>07 Hours</b>
Introduction to web technology, internet and www, Web site planning and design issues, HTML: structure of html document , HTML elements: headings, paragraphs, line break, colors & fonts, links, frames, lists, tables, images and forms, Difference between HTML and HTML5. CSS: Introduction to Style Sheet, Inserting CSS in an HTML page, CSS selectors, XML: Introduction to XML, XML key component, Transforming XML into XSLT, DTD: Schema, elements, attributes, Introduction to JSON.		
<b>Unit II</b>	<b>Client Side Technologies</b>	<b>08 Hours</b>
JavaScript: Overview of JavaScript, using JS in an HTML (Embedded, External), Data types, Control Structures, Arrays, Functions and Scopes, Objects in JS, DOM: DOM levels, DOM Objects and their properties and methods, Manipulating DOM, JQuery: Introduction to JQuery, Loading JQuery, Selecting elements, changing styles, creating elements, appending elements, removing elements, handling events.		
<b>Unit III</b>	<b>Server Side Technologies</b>	<b>08 Hours</b>
Introduction to Server Side technology and TOMCAT, Servlet: Introduction to Servlet, need and advantages, Servlet Lifecycle, Creating and testing of sample Servlet, session management. JSP: Introduction to JSP, advantages of JSP over Servlet , elements of JSP page: directives, comments, scripting elements, actions and templates, JDBC Connectivity with JSP.		
<b>Unit IV</b>	<b>Server Side Technologies</b>	<b>07 Hours</b>
PHP: Introduction to PHP, Features, sample code, PHP script working, PHP syntax, conditions & Loops, Functions, String manipulation, Arrays & Functions, Form handling, Cookies & Sessions, using MySQL with PHP, WAP & WML, AJAX: Introduction, Working of AJAX, AJAX processing steps, coding AJAX script.		



Unit V	Client and Server Side Frameworks	07 Hours
Angular JS : Overview, MVC architecture, directives, expression, controllers, filters, tables, modules, forms, includes, views, scopes, services, dependency injection, custom directives, Internationalization, Introduction to NodeJS. Struts: Overview, architecture, configuration, actions, interceptors, result types, validations, localization, exception handling, annotations.		
Unit VI	Web Services	08 Hours
Web Services: Overview, types of WS, difference between SOAP and REST, EJB: types of EJB, benefits, Architecture, EJB technology, JNDI lookup, Introduction to Content Management System(CMS) ,Wordpress / Joomla, Advanced Technology: Bootstrap, JSF, Spring.		
<b>Books:</b>		
<b>Text:</b> <ol style="list-style-type: none"> <li>1. Achyut Godbole &amp; Atul Kahate, "Web Technologies: TCP/IP to Internet Application Architectures", McGraw Hill Education publications, ISBN, 007047298X, 9780070472983</li> <li>2. Ralph Moseley &amp; M. T. Savaliya, "Developing Web Applications", Wiley publications, ISBN 13 : 9788126538676</li> </ol>		
<b>References:</b> <ol style="list-style-type: none"> <li>1. Adam Bretz &amp; Colin J Ihrig, "Full Stack Javascript Development with MEAN", SPD, ISBN-13: 978-0992461256</li> <li>2. Giulio Zambon, " Beginning JSP, JSF and Tomcat", Apress Publication, ISBN-10: 1430246235; ISBN-13: 978-1430246237</li> <li>3. Jeremy McPeak&amp; Paul Wilton," Beginning JavaScript", Wrox Publication, ISBN-13: 978-0470525937</li> <li>4. Black Book, "Struts 2", Dreamtech Press, ISBN 13, : 9788177228700</li> <li>5. Black Book, " JDBC 4.2, Servlet 3.1 &amp; JSP 2.3", Dreamtech Press, ISBN-13: 978-8177228700</li> <li>6. Sandeep Panda, "Angular JS: Novice To Ninja", SPD, First Edition 2014, ISBN-13: 978-0992279455</li> <li>7. B. V. Kumar, S. Sangeetha, S. V. Subrahmanya,, "J2EE Architecture, an illustrative gateway to enterprise solutions", Tata McGraw Hill Publishing Company. ISBN: 9780070621633</li> </ol>		

<b>Savitribai Phule Pune University</b> <b>Third Year of Computer Engineering (2015 Course)</b> <b>310255: Seminar and Technical Communication</b>		
<b>TUT: 01 Hour/Week</b>	<b>Credit 01</b>	<b>Examination Scheme: TW: 50 Marks</b>
<p><b>Course Objectives:</b></p> <ul style="list-style-type: none"> <li>To explore the basic principles of communication (verbal and non-verbal) and active, empathetic listening, speaking and writing techniques.</li> <li>To expose the student to new technologies, researches, products, algorithms, services</li> </ul>		
<p><b>Course Outcomes:</b></p> <p>On completion of the course, student will–</p> <ul style="list-style-type: none"> <li>be able to be familiar with basic technical writing concepts and terms, such as audience analysis, jargon, format, visuals, and presentation.</li> <li>be able to improve skills to read, understand, and interpret material on technology.</li> <li>improve communication and writing skills</li> </ul>		
<p><b>Guidelines:</b></p> <ul style="list-style-type: none"> <li>Each student will select a topic in the area of Computer Engineering and Technology preferably keeping track with recent technological trends and development beyond scope of syllabus.</li> <li>The topic must be selected in consultation with the institute guide.</li> <li>Each student will make a seminar presentation in the term making use of audio/visual aids for a duration of 20-25 minutes and submit the seminar report prepared in latex</li> <li>Active participation at classmate seminars is essential.</li> <li>A panel of staff members from the institute will assess the seminar internally during the Presentation.</li> <li>BoS circulated Seminar Log book is recommended to use</li> </ul>		
<p><b>Guidelines for Assessment:</b></p> <p>As a panel of staff members along with a guide would be assessing the seminar work based on these parameters-Contents and Presentation, Punctuality and Timely Completion, Question and Answers, Seminar Report, Paper presentation/Publication, Attendance and Active Participation.</p>		
<p><b>Recommended Format of the Seminar Report:</b></p> <ul style="list-style-type: none"> <li>Title Page with Title of the topic, Name of the candidate with Exam Seat Number, Roll Number, Name of the Guide, Name of the Department, Institution and Year</li> <li>Seminar Approval Sheet/Certificate</li> <li>Abstract and Keywords</li> <li>Acknowledgement</li> <li>Table of Contents, List of Figures, List of Tables and Nomenclature</li> <li>Chapters Covering topic of discussion- Introduction with section including organization of the report, Literature Survey/Details of design/technology/Analytical and/or experimental work, if any/ .....,Discussions and Conclusions ,Bibliography/References</li> <li>Plagiarism Check report</li> <li>Report Documentation page</li> </ul>		
<p><b>References:</b></p> <ul style="list-style-type: none"> <li>Rebecca Stott, Cordelia Bryan, Tory Young, “Speaking Your Mind: Oral Presentation and Seminar Skills (Speak-Write Series)”, Longman, ISBN-13: 978-0582382435</li> <li>Johnson-Sheehan, Richard, “Technical Communication”, Longman. ISBN 0-321-11764-6.</li> </ul>		

<b>Savitribai Phule Pune University</b> <b>Third Year of Computer Engineering (2015 Course)</b> <b>310256: Web Technology Lab</b>		
<b>Teaching Scheme:</b> <b>PR: 02 Hours/Week</b>	<b>Credit</b> <b>01</b>	<b>Examination Scheme:</b> <b>TW: 25 Marks</b> <b>PR: 50 Marks</b>
<b>Companion Course:</b> 310254-Web Technology		
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• To use current client side and server side web technologies</li> <li>• To implement communication among the computing nodes using current client side and server side technologies</li> <li>• To design and implement web services with content management</li> </ul>		
<b>Course Outcomes:</b> On completion of the course, student will be able to– <ul style="list-style-type: none"> <li>• develop web based application using suitable client side and server side web technologies</li> <li>• develop solution to complex problems using appropriate method, technologies, frameworks, web services and content management</li> </ul>		
<b>Guidelines for Instructor's Manual</b>		
The instructor’s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.		
<b>Guidelines for Student Journal</b>		
The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and <b>handwritten write-up</b> of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, <u>Theory- Concept/technology/tool in brief, design, test cases, conclusion/analysis.</u> <b>Program codes with sample output of all performed assignments are to be submitted as softcopy.</b>		
As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.		
<b>Guidelines for Assessment</b>		
Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.		

### Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

### Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

### Suggested List of Laboratory Assignments

1.	<p><b>Lab Assignment on Unit I:</b>  <b>Assignment 1a:</b> Installation and Configuration of Web Application Servers Tomcat, Apache, WebSphere, JBoss, GlassFish.  <b>Assignment 1b:</b> Design and develop any suitable web application using HTML, CSS and XML in consultation of course instructor.</p>
2.	<p><b>Lab Assignment on Unit II:</b>  <b>Assignment 2:</b> Perform validation of all fields in <b>assignment no.1</b> by using JavaScript/JQuery.</p>
3.	<p><b>Lab Assignment on Unit III:</b>  <b>Assignment 3:</b> Add dynamic web application essence in <b>assignment no. 2</b> using Servlet, JSP and backend.</p>
4.	<p><b>Lab Assignment on Unit IV:</b>  <b>Assignment 4:</b> Add dynamic web application essence in <b>assignment no. 2</b> using PHP, MySQL database connectivity and AJAX controls.</p>
5.	<p><b>Lab Assignment on Unit V:</b>  <b>Assignment 5:</b> Re-Design, develop and deploy <b>assignment no. 3 of unit –III</b> using Struts  Re-Design, develop and deploy <b>assignment no. 4 of unit –IV</b> using Angular JS</p>
6.	<p><b>Lab Assignment on Unit VI:</b>  <b>Assignment 6:</b> Design, Develop and Deploy separate web application using EJB/CMS/JSF/Spring/Bootstrap.</p>

#### Reference Books:

1. Aleksa Vukotic and James Goodwill, "Apache Tomcat 7", Apress, 2011.
2. Bryan Basham, Kathy Sierra, Bert Bates, "JSP: Passing the Sun Certified Web Component Developer Exam", O'Reilly Media ISBN: 978-0-596-51668-0, Second Edition, 2010.
3. Chirag Rathod, Jonathan Wetherbee, Peter Zdrozny, and Raghu R. Kodali, "Beginning EJB 3: Java EE 7 Edition", Apress, 2013.
4. Richard Monson-Haefel, "J2EE Web Services", Addison-Wesley Professional, First Edition, 2004.

5. Chuck Cavaness, “Programming Jakarta Struts”, O’relly Media, second edition 2004.
6. Michael Morrison, Lynn Beighley, “Head First PHP & MySQL: A Brain-Friendly Guide”, O’relly Media, second edition 2008.
7. Dan Rahmel, “Advanced Joomla!”, Apress, First Edition, 2013.  
Iwein Fuld, Marius Bogoevici, Mark Fisher, Jonas Partner”, Spring Integration in Action”, Manning, 2012.

**Savitribai Phule Pune University**  
**Third Year of Computer Engineering (2015 Course)**  
**310257: SP&OS Lab**

<b>Teaching Scheme:</b> <b>PR: 04 Hours/Week</b>	<b>Credit</b> <b>02</b>	<b>Examination Scheme:</b> <b>TW: 25 Marks</b> <b>PR: 50 Marks</b>
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**Companion Course:** 310251-Systems Programming and Operating System

**Course Objectives:**

- To implement basic language translator by using various needed data structures
- To implement basic Macroprocessor
- To design and implement Dynamic Link Libraries
- To implement scheduling schemes

**Course Outcomes:**

On completion of the course, student will be able to–

- Understand the internals of language translators
- Handle tools like LEX & YACC.
- Understand the Operating System internals and functionalities with implementation point of view

**Guidelines for Instructor's Manual**

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

**Guidelines for Student Journal**

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, Design, test cases, conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

**Guidelines for Assessment**

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

**Guidelines for Practical Examination**

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.





<b>Savitribai Phule Pune University</b> <b>Third Year of Computer Engineering (2015 Course)</b> <b>310258: Embedded Systems &amp; Internet of Things Lab</b>		
<b>Teaching Scheme:</b> <b>PR: 02 Hours/Week</b>	<b>Credit</b> <b>01</b>	<b>Examination Scheme:</b> <b>TW: 25 Marks</b> <b>PR: 50 Marks</b>
<b>Companion Course:</b> 310252-Embedded Systems & Internet of Things		
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• To understand functionalities of various single board embedded platforms fundamentals</li> <li>• To develop comprehensive approach towards building small low cost embedded IoT system.</li> <li>• To implement the assignments based on sensory inputs</li> </ul>		
<b>Course Outcomes:</b> On completion of the course, student will be able to– <ul style="list-style-type: none"> <li>• Design the minimum system for sensor based application</li> <li>• Solve the problems related to the primitive needs using IoT</li> <li>• Develop full fledged IoT application for distributed environment</li> </ul>		
<b>Guidelines for Instructor's Manual</b>		
The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.		
<b>Guidelines for Student Journal</b>		
The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and <b><u>handwritten write-up</u></b> of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, <u>Theory- Concept in brief, algorithm, flowchart, test cases, conclusion/analysis.</u> <b><u>Program codes with sample output of all performed assignments are to be submitted as softcopy.</u></b>		
As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.		
<b>Guidelines for Assessment</b>		
Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.		
<b>Guidelines for Practical Examination</b>		
Both internal and external examiners should jointly set problem statements. <u>During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement.</u> The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.		

### Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Set of suggested assignment list is provided in groups- A, B, C, D, and E. Each student must perform at least 13 assignments as at least 3 from group A, 3 from group B, 2 from group C, 2 from group D and 1 from group E.

### Suggested List of Laboratory Assignments

#### Group A

- |    |  |
|----|--|
| 1. | Study of Raspberry-Pi, Beagle board, Arduino and other micro controller ( History & Elevation)   |
| 2. | Study of different operating systems for Raspberry-Pi /Beagle board. Understanding the process of OS installation on Raspberry-Pi /Beagle board  |
| 3. | Study of Connectivity and configuration of Raspberry-Pi /Beagle board circuit with basic peripherals, LEDS. Understanding GPIO and its use in program.   |
| 4. | Understanding the connectivity of Raspberry-Pi /Beagle board circuit with temperature sensor. Write an application to read the environment temperature. If temperature crosses a threshold value, the application indicated user using LEDSs |

#### Group B

- |    |  |
|----|--|
| 5. | Understanding the connectivity of Raspberry-Pi /Beagle board circuit with IR sensor. Write an application to detect obstacle and notify user using LEDs.           |
| 6. | Understanding and connectivity of Raspberry-Pi /Beagle board with camera. Write an application to capture and store the image.                                     |
| 7. | Understanding and connectivity of Raspberry-Pi /Beagle board with a Zigbee module. Write a network application for communication between two devices using Zigbee. |
| 8. | Study of different CPU frequency governors. Write an application to change CPU frequency of Raspberry-Pi /Beagle board   |

#### Group C

- |     |  |
|-----|--|
| 9.  | Write an application using Raspberry-Pi /Beagle board to control the operation of stepper motor.                       |
| 10. | Write an application using Raspberry-Pi /Beagle board to control the operation of a hardware simulated traffic signal. |
| 11. | Write an application using Raspberry-Pi /Beagle board to control the operation of a hardware simulated lift elevator   |

#### Group D

- |     |   |
|-----|---|
| 12. | Write a server application to be deployed on Raspberry-Pi /Beagle board. Write client applications to get services from the server application.                   |
| 13. | Create a small dashboard application to be deployed on cloud. Different publisher devices can publish their information and interested application can subscribe. |
| 14. | Create a simple web interface for Raspberry-pi/Beagle board to control the connected LEDs remotely through the interface.   |

#### Group E

- |     |  |
|-----|--|
| 15. | Develop a Real time application like smart home with following requirements: When user enters into house the required appliances like fan, light should be switched ON. Appliances should also get controlled remotely by a suitable web interface. The objective of this application is student should construct complete Smart application in group. |
| 16. | Develop a Real time application like a smart home with following requirements: If anyone comes at door the camera module automatically captures his image send it to the email account of user or send notification to the user. Door will open only after user's approval.  |

**Savitribai Phule Pune University**  
**Third Year of Computer Engineering (2015 Course)**  
**310259: Audit Course 4**

In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement their knowledge and skills. Student will be awarded the bachelor's degree if he/she earns 190 credits and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

**Criteria:**

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. (Ref- [http://www.unipune.ac.in/Syllabi\\_PDF/revise-2015/engineering/UG\\_RULE\\_REGULATIONS\\_FOR\\_CREDIT\\_SYSTEM-2015\\_18June.pdf](http://www.unipune.ac.in/Syllabi_PDF/revise-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf))

**Guidelines for Conduction and Assessment (Any one or more of following but not limited to)**

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• Lectures/ Guest Lectures</li> <li>• Visits (Social/Field) and reports</li> <li>• Demonstrations</li> </ul> | <ul style="list-style-type: none"> <li>• Surveys</li> <li>• Mini Project</li> <li>• Hands on experience on specific focused topic</li> </ul> |
|---|--|

**Guidelines for Assessment (Any one or more of following but not limited to)**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>• Written Test</li> <li>• Demonstrations/ Practical Test</li> <li>• Presentations</li> </ul> | <ul style="list-style-type: none"> <li>• IPR/Publication</li> <li>• Report</li> </ul> |
|---|---|

**Audit Course 3 Options**

AC4- I	Digital and Social Media Marketing
AC4-II	Green Computing
AC4-III	Sustainable Energy Systems
AC4-IV	Leadership and Personality Development
AC4-V	Foreign Language (one of Japanese/ Spanish/French/German). Course contents for <b>Japanese (Module 4) are provided. For other languages institute may design suitably.</b>

**Savitribai Phule Pune University, Pune**  
**Third Year of Computer Engineering (2017 Course)**  
**310249: Audit Course 3**  
**AC4 – I: Digital & Social Media Marketing**

The importance of social media's role in modern marketing efforts can no longer be ignored. It's an integral component in almost all successful marketing strategies. With this increasing emphasis on integrated social media strategies, there is an Irrefutable need for marketing professionals and organizations to have end- to- end social media expertise. Through case studies, interactive sessions, and class exercises, students will learn best practices and develop the skills to connect business objectives with social media strategy, platforms and tactics. Topics will include choosing appropriate platforms, creating effective and engaging social media content, content management, social listening and creating a social media policy

**Course Objectives:**

- Identify best practices for Social Media Marketing, including platform level best practices.
- Connect business objectives to appropriate Social Media tactics.
- Create strong content that engages their target audience with their marketing message.

**Course Outcome:**

On completion of the course, learner will be able to–

- Create editorial calendars to manage content distribution.
- Use Social Listening tools to create timely, relevant content.
- Create Social Media policies that combine business objectives with appropriate use of social media channels and content.

**Course Contents:**

1. Introductions and review class objectives, Discuss class goals and individual goals, Fill out questionnaire, Introduction to Blogging, Create a blog post for your project. Include headline, imagery, links and post.
2. Introduction to Facebook and channel advertising and campaigns, Introduction to Twitter and channel advertising and campaigns, Creative Campaign examples across social channels
3. Introduction to both Google+ and LinkedIn. Provide an overview on LinkedIn advertising, Create Google+ and LinkedIn outlines for your project and include: types of posts and an example post for each platform.
4. Introduction to both Instagram and Pinterest as well as channel advertising and campaigns, Create Instagram and Pinterest outlines for your project and include: types of posts and an example post for each platform, review a content calendar, Lay out your own content calendar.

**References:**

1. Vandana Ahuja, Digital Marketing, Oxford Press, ISBN: 9780199455447,
2. Email Marketing: An Hour a Day, Wiley, Jeannie Mullen, David Daniels, David Gilmour- ISBN: 978-0-470-38673-6, 1stEdition.
3. The New Rules of Marketing and PR, David Scott, Wiley India, ISBN: 978-1-119-07048-1, 1stEdition.



**Savitribai Phule Pune University, Pune**  
**Third Year of Computer Engineering (2017 Course)**  
**310249: Audit Course 3**  
**AC4 – II: Green Computing**

Green computing is the study and practice of using computing resources efficiently. Green computing or green IT, refers to environmentally sustainable computing or IT. The goals of green computing are similar to green chemistry; reduce the use of hazardous materials, Maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste.

**Course Objectives:**

- To acquire knowledge to adopt green computing practices to minimize negative impacts on the environment.
- To examine technology tools that can reduce paper waste and carbon footprint by user.
- To understand how to minimize equipment disposal requirements.
- To gain skill in energy saving practices in their use of hardware

**Course Outcome:**

On completion of the course, learner will be able to–

- Understand the concept of green IT and relate it to sustainable development.
- Apply the green computing practices to save energy.
- Discuss how the choice of hardware and software can facilitate a more sustainable operation,
- Use methods and tools to measure energy consumption

**Course Contents:**

- 1. Fundamentals of Green IT:** Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot Print - Measuring, Details, reasons to bother, Plan for the Future, Cost Savings: Hardware, Power.
- 2. Green Assets and Power Problems:** Green Assets: Buildings, Data Centers, Networks, and Devices, Green Information Systems : Design and Development Models, Monitoring Power Usage, Servers, Low-Cost Options, Reducing Power Use, Data De-Duplication, Low-Power Computers and peripheral devices
- 3. Greening Information Systems:** Initial Improvement Calculations, Selecting Metrics, Tracking Progress, Change Business Processes, Customer Interaction, Paper Reduction, Green Supply Chain, Improve Technology Infrastructure, Reduce PCs and Servers, Shared Services, Hardware Costs, Cooling
- 4. Green Grid Framework:** Virtualizing of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center Case Studies – Applying Green IT Strategies and Applications to a Home Hospital, Packaging Industry and Telecom Sector

**References:**

1. Woody Leonhard, Katherrine Murray, “Green Home computing for dummies”, August 2009
2. Alvin Galea, Michael Schaefer, Mike Ebbers, “Green Data Center: steps for the Journey”, Shoff/IBM rebook, 2011.
3. John Lamb, “The Greening of IT”, Pearson Education, 2009.
4. Jason Harris, “Green Computing and Green IT- Best Practices on regulations & industry”, Lulu.com, 2008.
5. Bud E. Smith, “Green Computing Tools and Techniques for Saving Energy, Money and Resources”, CRC Press, 2014



**Savitribai Phule Pune University, Pune**  
**Third Year of Computer Engineering (2017 Course)**  
**310249: Audit Course 3**  
**AC4 – III: Sustainable Energy Systems**

**Course Objectives:**

- To understand the impact of engineering solutions on a global, economic, environmental, and societal context.
- To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

**Course Outcome:**

On completion of the course, learner will be able to–

- To demonstrate an overview of the main sources of renewable energy.
- To understand benefits of renewable and sustainable energy systems.

**Course Contents:**

1. Introduction and Energy Fundamentals, Sustainable Energy Systems: Issues for the 21st century, the critical challenges for a sustainable energy future, Sustainable energy systems: definitions, indicators, Physics of Energy: Laws of Thermodynamics Energy Forms and Conversion, First and Second Laws and Efficiencies Devices: Heat Engines, Refrigerators and Heat Pumps Instantaneous and Average Power.
2. Introduction to Renewable Energy, Wind Energy Wind Turbine Technologies Wind Resources and Modeling Energy Performance and Environmental Impacts Economics and Economic Development Impacts, Photovoltaic: PV and BIPV Technologies Solar Resources and Modeling Energy Performance and Environmental Impacts, Economics and Net Metering
3. Biomass: Electricity Biomass Technologies Introduction Biomass Productivity and Modeling Biopower: MSW, willows/switch grass/ poplar, wood waste, Biomass: Transport Fuels Biofuels , Bioethanol, Biodiesel, Algal, Jatropha Biofuels and Water Land Use Impacts, Food vs Fuel, Renewable Fuels Standards
4. Building Energy Technologies and Policy, Smart buildings, Lighting and LEDs, Heating/cooling, technologies.

**References:**

1. İbrahim Dinçer, Calin Zamfirescu , “Sustainable Energy Systems and Applications “
2. D. Mukherjee ,”Fundamentals of Renewable Energy Systems”,
3. John R. Barker and Marc H. Ross Am. J. Phys , “An introduction to global warming”,

**Savitribai Phule Pune University, Pune**  
**Third Year of Computer Engineering (2017 Course)**  
**310249: Audit Course 3**  
**AC4 – IV: Leadership and Personality Development**

Personality is considered as one of the integral part of an individual's existence. Where a student is concerned paying close attention to **Personality** which is extremely important. To enhance holistic development of students and improve their employability skills

**Course Objectives:**

- To develop inter personal skills and be an effective goal oriented team player.
- To develop professionals with idealistic, practical and moral values.
- To develop communication and problem solving skills.
- To re-engineer attitude and understand its influence on behavior

**Course Outcome:**

On completion of the course, learner will be able to–

- Enhanced holistic development of students and improve their employability skills

**Course Contents:**

- 1. Introduction to Personality and working towards developing it:** Definition & Basics of personality, Analyzing strength & weaknesses, Corporate theories on personality Development, Increasing Vocabulary, Body Language, Preparation of Self Introduction
- 2. Communication skill and handling attitude:** Communication Skills, Listening, Communication Barriers, Overcoming these Barriers Building Self Esteem and Self Confidence, Working on attitudes .i.e. aggressive, assertive, and submissive
- 3. Leadership Techniques in Personality development:** Introduction to Leadership, Leadership Styles, Group Dynamics, Team Building
- 4. Stress and time management skills:** Interpersonal Relationships, Analysis of Ego States, transactions, & Life positions, Stress Management, Causes, Impact & Managing Stress, Introduction to conflict management, Time Management, Concept of time management, Steps towards better time management

**References:**

1. SOFT SKILLS, 2015 Career Development Centre, Green Pearl Publications
2. Covey Sean Seven Habits of Highly Effective Teens, New York, Fireside Publishers, 1998.
3. Carnegie Dale, How to win Friends and Influence People, New York: Simon & Schuster, 1998.
4. Thomas A Harris I am ok, You are ok , New York Harper and Row, 1972
5. Daniel Coleman, Emotional Intelligence, Bantam Book, 2006

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**Third Year of Computer Engineering (2017 Course)**  
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**AC4 – V: Foreign Language(Japanese Module 4)**

**About Course:**

With changing times, the competitiveness has gotten into the nerves and ‘Being the Best’ at all times is only the proof of it. Nonetheless, ‘being the best’ differs significantly from ‘Communicating the best’. The best can merely be communicated whilst using the best suited Language!

Japanese is the new trend of 21st century. Not only youngsters but even the professionals seek value in it. It is the engineer’s companion in current times with an assertion of a thriving future. Pune has indisputably grown to become a major center of Japanese Education in India while increasing the precedence for Japanese connoisseurs.

Japanese certainly serves a great platform to unlock a notoriously tough market & find a booming career. While the companies prefer candidates having the knowledge of the language, it can additionally help connect better with the native people thus prospering in their professional journey. Learning Japanese gives an extra edge to the ‘resume’ since the recruiters consciously make note of the fact it requires real perseverance and self-discipline to tackle one of the most complex languages.

It would be easy for all time to quit the impossible; however it takes immense courage to reiterate the desired outcomes, recognize that improvement is an ongoing process and ultimately soldier on it. The need of an hour is to introduce Japanese language with utmost professionalism to create awareness about the bright prospects and to enhance the proficiency and commitment. It will then prove to be the ultimate path to the quest for professional excellence!

**Course Objectives:**

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

**Course Outcome:**

On completion of the course, learner will be able to–

- Have ability of basic communication.
- Have the knowledge of Japanese script.
- Get introduced to reading, writing and listening skills for language Japanese.
- Develop interest to pursue professional Japanese Language course

**Course Contents:**

1. Stating existence or a presence of thing (s), person (s), Relative positions, Counters
2. Expressing one’s Desire & wants, Verb groups, Asking, Instructing a person to do something
3. Indicating an action or motion is in progress, Describing habitual action, Describing a certain continuing state which resulted from a certain action in the past. Express permission & prohibition

**References:**

1. Minna No Nihongo, —Japanese for Everyone, Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.
2. <http://www.tcs.com> ([http://www.tcs.com/news\\_events/press\\_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx](http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx))

### Computer Engineering Courses

First Year	Second Year	Third Year	Fourth Year (Proposed)
<b>Semester I</b>			
FPL I	Discrete Structures & Graph Theory	Theory of Computation (TOC)	Parallel Architectures and Parallel Computing
Engineering Maths I	Digital Electronics and Logic Design	Database Management Systems (DBMS)	Wireless Sensor Networks
Engineering Physics	Data Structures and Algorithms	Software Engineering & Project Management (SE & PM)	Compiler Construction
Basic Electrical Engineering	Computer Organization and Architecture	Information Systems & Engineering Economics (IS & EE)	Information Security
Engineering Graphics I	Object Oriented Programming	Computer Networks (CN)	Elective I – <ul style="list-style-type: none"> <li>• Digital Signal Processing</li> <li>• Big data Analytics</li> <li>• Advanced Databases,</li> <li>• Artificial Intelligence,</li> </ul>
Basic Civil and Environmental Engineering	Digital Electronics Lab	Skill Development Lab (SDL)	Elective II- <ul style="list-style-type: none"> <li>• Distributed Operating Systems,</li> <li>• Soft Computing,</li> <li>• Software Architecture,</li> <li>• Operation Research</li> </ul>
Workshop Practice	Data Structures Lab	DBMS Lab	Project Stage I
Engineering Physics Lab	Object Oriented Programming Lab	CN Lab	Lab I and Lab II
	Soft Skills	Audit Course 3	Project Stage I
	Audit Course 1	---	Audit Course 5
<b>Semester II</b>			
FPL II	Engineering Mathematics III	Design & Analysis of Algorithms (DAA)	Distributed Systems
Engineering Maths II	Computer Graphics	Systems Programming & Operating System (SP& OS)	Data Mining & Data Warehouse
Engineering Chemistry	Advanced Data Structures	Embedded Systems & Internet of Things (ES & IoT)	Mobile Communications
Basic Electronics Engineering	Microprocessor	Software Modeling and Design (SDM)	Project Work
Basic Mechanical Engineering	Principles of Programming Languages	Web Technology (WT)	Lab III and Lab IV
Engineering Mechanics	Computer Graphics Lab	Seminar & Technical Communication	<b>Elective-III :</b> <ul style="list-style-type: none"> <li>• Cloud Computing,</li> <li>• Mobile Communication,</li> <li>• Image Processing</li> <li>• Bio-Informatics,</li> </ul>
Engineering Graphics II	Advanced Data Structures Lab	Web Technology Lab	<b>Elective-IV :</b> <ul style="list-style-type: none"> <li>• Software Testing &amp; QA,</li> <li>• Embedded OS,</li> <li>• Cyber Security &amp; Forensic</li> <li>• Open Elective</li> </ul>
Engineering Chemistry Lab	Microprocessor Lab	SP & OS Lab	Audit Course 6
	Audit Course 2	ES & IoT Lab	
		Audit Course 4	